PORTSMOUTH HARBOR AND PISCATAQUA RIVER

NEW HAMPSHIRE AND MAINE

SURVEY REVIEW OF REPORTS

INTERIM REPORT ON COMMERCIAL CHANNEL

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

JANUARY 31, 1962

INTERIM REPORT ON PORTSMOUTH HARBOR AND PISCATAQUA RIVER, NEW HAMPSHIRE AND MAINE

SYLLABUS

The Division Engineer finds that the locally desired improvement for Portsmouth Harbor and the Piscataqua River is warranted in that prospective benefits are sufficient to justify the improvement. He recommends modification of the existing 35-foot deep Federal project channel to provide for widening at bends, and extension of the 35-foot channel to the Newington, New Hampshire terminals with provision for two turning basins, all as shown on the map accompanying this report. The estimated cost to the United States is $7,500,000 for new work, plus a cost of $21,000 for aids to navigation, $20,000 for preauthorization study costs, and $10,000 for additional annual channel maintenance for the upper reach of the project. The improvement, which will benefit commercial navigation, has a benefit-cost ratio of 2.1 to 1.

TABLE OF CONTENTS

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 Trapelo Road
Waltham 54, Mass.

NEDGW 31 January 1962

SUBJECT: Survey (Review of Reports) of Portsmouth Harbor and Piscataqua River, New Hampshire and Maine, Interim Report on Commercial Channel

TO: Chief of Engineers, ATTN: ENGCW-P, Department of the Army, Washington 25, D. C.

AUTHORITY

1. This report is submitted in compliance with resolutions adopted 18 November 1958 by the Committee on Public Works of the United States Senate and 3 June 1959 by the House Committee on Public Works, as quoted below,

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved 13 June 1902, be, and is hereby, requested to review the report of the Chief of Engineers on Portsmouth Harbor and Piscataqua River, Maine and New Hampshire, published as House Document No. 556, Eighty-second Congress, Second Session, with a view to determining whether any modification of the existing project is advisable at the present time."

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Portsmouth Harbor and Piscataqua River, Maine and New Hampshire, submitted in House Document No. 556, 83rd Congress, 2nd Session, and prior reports, with a view to determining whether modification of the existing project in any way is advisable at this time."

PURPOSE AND EXTENT OF STUDY

2. The purpose of this study is to determine the need and justification for improvement of Portsmouth Harbor and Piscataqua River for deep-draft commercial navigation by widening the 35 foot channel in Portsmouth Harbor and the lower reaches of Piscataqua River by the removal of ledge rock, and for extending the channel through the upper

reaches of the Piscataqua River to the oil terminals at Newington by dredging of gravel shoals in the channel. The study also includes consideration of the need for dredging the so-called back channels between the islands scattered along the south side of Portsmouth Harbor to provide a shallow draft channel for small boating. Authority was received from the Chief of Engineers 27 December 1961 to consider these two subjects in separate reports although based on the same Congressional authorization. This report is the first of the two reports that will be submitted, and deals with the proposals for deep-draft navigation improvements.

3. A public hearing was held on 24 May 1960 in Portsmouth, New Hampshire in order to obtain the views of local interests. At the hearing local interests expressed their desires for channel improvements in the Piscataqua River and the back channels connecting Portsmouth Harbor and to Little Harbor.

DESCRIPTION OF NAVIGATION CONDITIONS

4. The Piscataqua River forms a portion of the boundary between the States of Maine and New Hampshire. The mouth of the river is called Portsmouth Harbor. The river is about 13 miles long and has high velocity current flows and a tortuous channel with sharp bends and submerged ledges, making navigation for deep-draft vessels hazardous. The river begins at the confluence of the Salmon Falls and Cocheo Rivers and flows in a southerly direction for about 4 miles to a point where it receives the discharge of a large tidal basin, consisting of Great Bay and its tributary rivers, which result in severe tidal currents that limit navigation to slack water periods. Below the junction with the Great Bay waterway system, the Piscataqua River swings southeast for a distance of about 2½ miles to Boiling Rock, where it narrows in width, and then meanders to Portsmouth Harbor passing under the Interstate and Memorial highway bridges at Nobles and Badgers Island. Portsmouth Harbor is located 45 miles northeast of Boston Harbor and 37 miles southwest of Portland Harbor. The tide ranges are 7.8 feet (mean) and 9.0 feet (spring). Rapid tidal currents exist throughout the entire river. The average velocity at full strength of the current varies from about 2.6 knots to 4.0 knots.

TRIBUTARY AREA

5. The immediate tributary area of Portsmouth Harbor and Piscataqua River comprises the city of Portsmouth, New Hampshire, the town of Newington, New Hampshire, and the towns of Kittery and Eliot, Maine.

In 1960 Portsmouth had a population of 25,833, Newington 2,499, Kittery 10,869, and Eliot 3,133. The principal industries of the area are the manufacture of shoes and gypsum products, generation of electrical power, operation of bulk coal and petroleum production terminals and the Portsmouth Naval Base (in Kittery) and the U. S. Air Force base (in Newington). Within 15 miles of Portsmouth are the cities of Dover and Somersworth with populations of 19,131 and 8,529 respectively and the towns of Durham, Newmarket, and South Berwick with a combined population of 10,545. These centers are principally engaged in textiles, leather and leather products and electrical equipment. The Boston and Maine Railroad serves most communities in the area including Portsmouth, N. H. and Kittery, Maine with a branch line along the westerly bank of the Piscataqua River on which the major industries are located. The area is also served by bus lines and trucking companies operating over a network of hard-surfaced roads.

BRIDGES AFFECTING NAVIGATION

6. Two bridges cross the main channel of the river within the harbor area. The Interstate Highway and railroad bridge at Nobles Island is a vertical lift bridge with a horizontal clearance of 200 feet, and a minimum vertical clearance of 135 feet above mean high water in the open position and 10.2 feet in the closed position. The bridge spans the river from the city of Portsmouth, New Hampshire, to the town of Kittery, Maine and is located about 4.0 miles from the mouth. The Memorial Highway bridge at Badgers Island is a vertical lift bridge with a horizontal clearance of 260 feet and a minimum vertical clearance of 150 feet above mean high water in the open position and 19.1 feet in the closed position. The bridge crosses the river from the city of Portsmouth, New Hampshire to the town of Kittery, Maine, and is located about 3.5 miles above the mouth.

PRIOR REPORTS

7. Portsmouth Harbor and Piscataqua River have been the subject of several previous reports. These are described in the following table:

PUBLISHED IN	NATURE AND DATE OF REPORT	WORK CONSIDERED AND RECOMMENDATIONS
H. Ex. Doc. No. 84, 43d Cong., 1st Session	Preliminary Examination 1873	Breakwater between Gerrish and Wood Islands. Estimated Cost $150,000. Favorable
Sen. Ex. Doc. No. 29, 45th Cong., 3d Session	Survey 1878	Closing channel between New Castle Island and Goat Island to eliminate strong currents. Remove portion of Gangway Rock to 20 feet below mean low water. Remove part of Badgers Island to 10 feet at mean low water. Favorable
Sen. Ex. Doc. No. 30, 48th Cong., 1st Session	Preliminary Examination and Survey. 1882	Extension and completion of breakwater between Goat Island and New Castle Island. Unfavorable
Sen. Ex. Doc. No. 44, 48th Cong., 1st Session	Preliminary Examination and Survey. 1883	Construction of dam near mouth of Great Bay to maintain high water level navigation above and eliminate strong currents below. Unfavorable
H. Ex. Doc. No. 71, 48th Cong., 2d Session	Preliminary Examination 1884	Improvement of Portsmouth Harbor. Unfavorable
H. Doc. No. 39, 56th Cong., 1st Session	Preliminary Examination 1899	Removal of "Pull-and-Be-Damned Point. Unfavorable
H. Doc. No. 263, 56th Cong., 2d Session	Preliminary Examination and Survey. 1900	Remove portion of Henderson Point to Improve Navigation into Navy Yard at Kittery. Favorable - completed by Navy
H. Doc. No. 1086 61st Cong., 3d Session	Preliminary Examination (Review of Reports) 1909	Construction of lock and dam in Piscataqua River Unfavorable

PUBLISHED IN	NATURE AND DATE OF REPORT	WORK CONSIDERED AND RECOMMENDATIONS
H. Doc. No. 1010 64th Cong., 1st Session	Preliminary Examination 1915	Removal of South Beacon Shoal, Part of Shoal off Badgers Island, Part of Gangway Rock, Goat Island and Seawards Rock, all to a depth of 30 feet below mean water. Unfavorable
H. Doc. No. 556 82d Cong., 2d Session	Survey (Review of Reports) 1952	Removal of ledge rock in the vicinity of Gangway Rock, the southwest point of Badgers Island and Boiling Rock to 35 feet below mean low water. Favorable

EXISTING CORPS OF ENGINEERS PROJECT

8. The original Corps of Engineers project in the waterway was for Portsmouth Harbor only and was authorized by the River and Harbor Act of 1879 and modified in 1890. It provided for a stone breakwater extending from Goat Island to Newcastle Island, the removal of a portion of ledge-rock on the southeast side of Badgers Island to a depth of 18 feet below mean low water, and the removal of Pier rock to a depth of 12 feet below mean low water.

9. Work on the project was initiated in 1879 and the entire project completed in 1892. The breakwater, which was designed to eliminate dangerous cross currents in the vicinity of Goat Island ledge, was completed in 1881. Removal of part of Gangway Rock to 20 feet began in 1881 and was completed in 1888. Removal of ledge at the southwest point of Badgers Island to 18 feet was started in 1881 and completed in 1891. Removal of Pier Rock to 12 feet as authorized by the River and Harbor Act of 1890 was accomplished in the two year period 1891 to 1892. The total expenditures in Portsmouth Harbor for these early projects were $130,392.61, all of which was for new work.

10. House Document No. 556, 82d Cong., 2d Session provided for the removal of ledge-rock in the vicinity of Gangway Rock, the southwest point of Badgers' Island and Boiling Rock to 35 feet below mean low water. Construction of the project was initiated and completed in 1956. The total expenditure for this project was $1,175,000 all of which was for new work.

LOCAL COOPERATION ON EXISTING AND PRIOR PROJECTS

11. Local cooperation was not required on the existing or prior projects.

OTHER IMPROVEMENTS

12. State or local authorities have provided no improvement for the benefit of general navigation. However, Portsmouth, New Hampshire, and Kittery, Maine, have provided free public landings for the use of small craft in Portsmouth Harbor. About 60 years ago the Navy removed a portion of Henderson Point to improve navigation into the naval base. In August 1960, a portion of the shoal in the upper reach of the river was dredged by the New England Tank Industries to allow T-2 tankers access to their new terminal, then being constructed to handle petroleum products for Pease Air Force Base.

TERMINAL AND TRANSFER FACILITIES

13. Waterfront terminals in Portsmouth Harbor are situated chiefly on the south bank of the Piscataqua River in Portsmouth and Newington. The U. S. Navy Yard is on the opposite bank at Kittery, Maine. A total of 18 piers, wharves and landings represent the available terminals for handling the port's waterborne commerce. The Navy Yard at Seavey Island is not used for commercial activities. The major terminal facilities are on the New Hampshire side. On the Maine side of the river are a town landing, a coal dock used by barges, and a lobster dock, all on the channel north of Badgers Island. Of the New Hampshire terminals, 4 are used exclusively for the receipt of petroleum products, and two receive coal and gypsum rock in addition to receiving products of the petroleum industry. Other facilities include one used for handling minerals, one for the shipment of wire and cable, and one used for mooring a floating power plant. At Portsmouth are 2 docks for the receipt of fish and lobsters, a public landing and three facilities currently not used for handling waterborne commerce, although used for vessel mooring and landings. There are a number of private recreational boat docks.

14. The greater tonnages of petroleum products are received at five waterfront terminals. The 4 that are operated as petroleum receiving terminals only are: the Coleman Oil Company landing, the Socony Mobil Oil Company pier, the New England Tank Industries pier and the Atlantic Terminal Sales Corporation pier. The Coleman Oil Company landing is located along the west side of the old Boston and Maine Railroad wharf, now obsolete. The landing is a 4-foot square platform with catwalks extending laterally to provide 200 feet of

18-foot berthing space. Pipelines on the landing connect with 10 storage tanks with a capacity of 26,100 barrels on Nobles Island nearby. Further upstream is the Socony Mobil Oil Company, also used by the Public Service Company of New Hampshire, with oil storage capacity of 395,000 barrels. The pier is an offshore wharf with landings and breasting dolphins in line with the wharf face, and all are joined with the shore by two approaches. The available berthing space with dolphins is 650 feet, with a 35-foot depth of water alongside. The terminal of the New England Tank Industries in Newington, above the upstream limit of the existing project, was constructed during 1961. The pier consists of sheet pile cells connected by a walk way and pipelines to shore and storage tanks of 360,000 barrel capacity. The berth is 650 feet long and 35 feet deep. This facility supplies petroleum products to the Pease Air Base. The Atlantic Terminal Sales Corporation maintains a T-head wharf of timber and pile construction with a 12-foot berth and a sheet steel and pile offshore pier, constructed in 1960, at Newington. This is the furthest upstream facility at the port. The 650-foot berth is 35 feet deep. Several oil companies use this terminal to receive petroleum products by barge and tankers for storage in tanks of 340,000 barrel capacity in rear of the wharf. There are rail sidings and truck loading racks at this terminal for shipment of oil.

16. Other facilities over which petroleum products are received include the National Gypsum Company Wharf also used by the Esso Standard Oil Company. This dock has a 40-foot deep berth for gypsum carriers and a 15-foot berth for oil barges. The oil storage capacity is 207,000 barrels. The C. H. Sprague and Son Co. Coal Pier, one of the largest facilities at the port, has storage facilities for 100,000 tons of coal and 342,000 barrels of oil. It is used to receive coal and petroleum products and also provides bunkering services to vessels. The concrete pile timber wharf is 440 feet long with a berth depth of 36 feet.

17. The only other deep-draft terminal is the timber wharf recently purchased by the Granite State Minerals Corporation below Nobles Island. The 260-foot berth is 14 to 26 feet deep, and will be used by Liberty type cargo vessels. The New Hampshire Port Authority has purchased Nobles Island for development as a public cargo terminal. Plans are being developed to provide 2 or 3 berths.

18. The Naval Base, located on Seavey Island, opposite Gangway Rock, has a number of wharves adjacent to the channel in Piscataqua River, which are used in connection with the construction and repair of naval craft. Petroleum products and other commodities for Navy use are received at these wharves.

IMPROVEMENTS DESIRED

19. At a public hearing held on the 24 May 1960 at Rockingham Hotel, Portsmouth, New Hampshire, local interests expressed their desires for improvements in the Piscataqua River and the back channels of Portsmouth Harbor and Little Harbor. Present at the hearing were representatives of the U. S. Naval Base, Portsmouth, N. H., and the U. S. Coast Guard, representatives of the various industries and local interests and residents of the area.

20. The improvements proposed at the hearing relative to Piscataqua River were as follows:

a. Widen the bend between the western tip of Seavey Island and Gangway Rock to a depth of 35 feet below mean low water.

b. Widen the bend at the southwesterly point of Badger's Island to a depth of 35 feet below mean low water.

c. Remove the 28 foot shoal area on the upstream side of the Interstate Highway-Railroad bridge to a depth of 35 feet below mean low water.

d. Remove further section of Boiling Rock to provide a channel width of 750 feet to permit an adequate turning area for larger vessels when leaving the terminals.

e. Dredge the channel leading to the Atlantic Terminal Sales Corporation terminal at Newington to 35 feet below mean low water for a width of 400 feet and provide lighted navigation aids.

21. In addition to the improvements requested for the deep-draft channel through the harbor and up the Piscataqua River, local interests also seek improvements of the back channel connecting Portsmouth Harbor and Little Harbor. The improvements desired are for small fishing craft and recreational navigation. The study of small boat needs is currently underway and will be the subject of a separate report.

22. Local desires for improvement on the Piscataqua River and Portsmouth Harbor is based upon the expanding industrial use of the seacoast region of New Hampshire. The importance of the seacoast region to the economy of New Hampshire has been substantiated by the fact that it is one of the State's fastest growing regions. This growth is measured by (1) the expansion of existing business and the number of new industries that have been established over the past two decades, (2) by substantial increases in cargo tonnages handled

by the harbor, and (3) from the increase in population experienced since 1950. The continued improvement of Portsmouth Harbor resources is vital to the economy of New Hampshire. Projected growth trends of existing harbor oriented industries indicate they will require ever increasing amounts of raw materials to service the growing needs of this region and the State of New Hampshire. Notable among the Portsmouth tidewater industries are the power plant, the gypsum plant, the coal and oil depots, the Navy Yard, the wire and cable plant in Newington, a metal fabricator plant, a navigation company and the lobster and fish industries. Recent area wide studies indicate that there is a potential for establishing additional harbor oriented industries. Such potential industries would handle forest products, cement, salt, bulk cargoes, and include processing and manufacturing plants. The nation wide shortage of available tidewater industrial sites is expected to accelerate the establishment of such business in the Portsmouth area.

COMMERCE

23. Petroleum, gypsum, wire cable, and coal constitute the principal items of waterborne commerce for Portsmouth Harbor and Piscataqua River. The tonnages handled during the period 1951 to 1960 is tabulated below.

Year	Short Tons	Passengers	Year	Short Tons	Passengers
1951	863,335	15,432	1956	1,328,758	20
1952	919,214	9,987	1957	1,308,499	5,262
1953	956,860	12,934	1958	1,219,120	10,962
1954	905,693	16,658	1959	1,315,369	10,960
1955	1,206,443	8,740	1960	1,397,389	8,133

24. The use of the waterway is expected to increase in the future. Commerce in petroleum products, estimated at 1,397,000 tons for 1961, is estimated to increase at least in proportion to increased demand for the nation, to total 7,300,000 tons in 2061. (See Appendix B). The Atlantic Terminal Sales Corporation and the New England Tank Industries have both recently completed docks capable of accommodating the berthing and discharging of T-2 and supertankers. The Simplex Wire and Cable Co. has indicated that their annual increase of export tonnage of cable through the period 1954 to 1959 has been 3 percent and that the total value of cables shipped from their Newington plant by cable ships and ocean carriers during the above period and through calendar year 1960 amounted to over one hundred eleven million dollars. The commodities handled on the Piscataqua River in 1960 is shown below:

1960 Commerce by Commodity	Imports Sh.Tons	Exports Sh.Tons	Coastwise Receipts Short Tons
Bituminous coal & lignite			77,054
Petroleum products	539,061		667,317
Gypsum or plaster rock	110,868		
Steel, metal parts, electrical machinery & misc.	145	2,944	
	650,074	2,944	744,371

Total (does not include government tonnage or any tonnage to the U. S. Navy Yard) 1,397,389 (Short tons)

VESSEL TRAFFIC

25. Deep draft vessel traffic consists of tankers, colliers and dry bulk cargo vessels. Since the existing Federal project was completed, in 1956, the size of the largest tanker entering Portsmouth has increased from 16,700 Deadweight Tons to 27,000 DWT. The improvement desired is expected to result in use of tankers up to 35,000 DWT. The trips and drafts of vessels for 1960 are given below.

1960 Trips and Drafts of Vessels

Draft (feet)	Passenger and Dry Cargo		Tanker		Towboats Barges & Others		Total	
	In	Out	In	Out	In	Out	In	Out
35			1				1	
34			2				2	
33			1				1	
32			8				8	
31			17				17	
30	1		17				18	
29	5		2			2	7	2
28	1		1				2	
27								
26			1	1			1	1
25			5	3			5	3
19-24		1	11	45	3	2	14	48
18 & less	196	202	96	104	27	25	319	331
Total	203	203	162	153	30	29	395	385

DIFFICULTIES ATTENDING NAVIGATION

26. Piscataqua River is characterized by rapid moving currents, abrupt directional changes and submerged ledges at some locations coupled with hazardous cross currents. General navigation throughout the length of the Piscataqua River is hampered by rapid tidal currents. The irregularities of the river width and depth plus the abrupt directional changes of its course result in changes in the direction of the currents. The velocities of these currents vary at various locations because of the irregularities of the river's width and depth. The maximum average velocity in the river occurs north of Nobles Island and amounts to 4.0 knots. As a result of the combination of the rapid tidal currents and hazardous cross currents, navigation of deep-draft vessels is limited to the three-hour period consisting of 1-1/2 hours before and after slack water.

27. The problems involved in handling large vessels due to the strong tidal currents effectively rules out docking or undocking at terminals at any time other than periods of slack water. The lack of turning room in the river, together with the poor holding ground makes it impossible to stop and anchor, once a vessel enters the river. The rocky nature of the bottom further complicates the situation, whereby an otherwise minor grounding or touching the channel edge would result in serious damage to the vessel. The alignment of the Interstate Bridge with relation to the axis of the channel, is an angle of approximately 30 degrees. For this reason, the 200-foot horizontal clearance through the bridge, which would normally be ample, is barely adequate for large vessels. A high degree of ship-handling skill is therefore required for safe navigation through the bridge.

28. There are other hazards which would make the difference between an acceptable and an unacceptable risk to the navigation of larger vessels. Large vessels are unable to turn around at some of their berthing terminals without running the risk of serious damage to the vessel by touching the channels' edge or minor grounding, therefore in order for a large vessel to turn around, it is necessary to proceed some distance upstream. In addition to the time lost in going upstream an earlier start is required to pass through the bridges before the current has increased in velocity. Because of the position of the opening in the upstream bridge, vessels passing through the bridge must maneuver near the easterly channel edge in transiting the area just northwest of Badgers Island. In proceeding to and from this area, vessels must pass near the ledge at the bend of the southwest point of Badgers Island in order to avoid losing control because of the cross currents which sweep toward the opposite shore.

29. Hazardous navigation conditions exist at Gangway Rock. At this point, the natural channel makes a sharp turn around the rock. In order to avoid striking the ledge and to have proper maneuvering area to make the turn, large vessels must steer a course near Seavey Island, such a course must allow sufficient clearance in order to avoid collision with naval vessels at the piers. Since navigation of large vessels is restricted to slack water periods, merchant vessels must pass the area while naval vessels are being towed between piers.

30. Boiling Rock is a ledge area on a bend on the northern bank of the river on the opposite side from the Public Service Company of New Hampshire's power plants, the Socony-Mobil Oil Company's terminal and the C. H. Sprague and Son coal and oil terminal. Due to the location of these industrial developments, the natural channel of the river is narrowed by the wharves serving these companies and by the permanently anchored floating power plant S. S. Resistance. The restricted channel is further reduced when large vessels are tied up at the wharves. Vessels in transit in this area must steer a course near the wharves to provide safe clearance of the ledge and ample space to make the turn. Operations in this area restrict such a course, and navigation of large vessels is generally difficult. Vessels moored at these wharves vary in length from 440 to 630 feet. The existing project channel, whose controlling dimensions were based on smaller vessels, is inadequate for larger vessels.

31. The channel above Boiling Rock to the Atlantic Terminal Sales Corporation and tank storage depot, is inadequate to accommodate vessels over 18,000 DWT. A new dock at the above terminal was completed in 1960. The New England Tank Industries terminal construction in 1960 included sufficient dredging of high spots in the channel to allow high water slack operation of T-2 tankers. The present channel depth imposes an economic hardship on the shippers and receivers of petroleum products, by preventing the use of larger vessels. The 17,922 DWT tanker Ticonderoga grounded on the shoal on the south side of the river about 2,000 feet downstream from the Atlantic Terminal Sales dock on 30 December 1961. The report indicates the vessel was outbound at low water slack with a draft of 23 feet aft and attended by two tugs. Damage was estimated at $200,000. No other major accidents have been reported in the harbor since completion of the existing project in 1956.

WATER POWER AND OTHER SPECIAL SUBJECTS

32. The waterway is tidal. There is no problem of water power, flood control, pollution or any related subject. The U. S. Fish and Wildlife Service anticipates no significant adverse effects on the fish and wildlife resources as the result from the requested improvements. Their report is included in Appendix C.

PLAN OF IMPROVEMENT

33. Consideration has been given to the improvement desired for the deep-draft ship commercial channel of Portsmouth Harbor and Piscataqua River. The selected plan will meet the desires of shipping interests with deep-water terminals located up river as far as Newington to the extent that it would provide safer navigation and decrease operational costs for deep-draft vessels utilizing the waterway with load capacities from 17,000 tons to 37,600 tons. Adequate channel width is essential for deep-draft vessels to provide for maneuvering in making turns and in passing other vessels. The plan provides for improvement of the river channel from Henderson Point to Newington, beginning with widening of the bends to a depth of 35 feet below mean low water at Henderson Point, Gangway Rock, and the southwesterly point of Badger's Island. It includes widening of the channel between Badger's Island and Nobles' Island and widening of the bend to the east of Maine-New Hampshire Interstate Bridge to provide a better approach to the bridge. The 26-foot shoal at the south edge of the channel west of the Maine-New Hampshire Interstate Bridge is to be removed. The bend at Boiling Rock is to be widened, including removal of the pinnacle of Boiling Rock, and a 950-foot wide turning basin constructed immediately upstream. The plan also includes improving the channel from Boiling Rock to Newington to a depth of 35 feet generally 400 feet wide and providing a turning basin 850-feet wide by dredging shoals. Local and commercial shipping interests have advised that this improvement would meet their present needs and desires.

34. The selected plan was designed to permit the use of vessels of 35,000 DWT (715 feet long, 93 foot beam, with draft of 35 feet) at high water slack. Additional deepening to permit operation of these vessels at low water slack, or larger vessels at high water slack, was considered but the increased cost is far greater than the probable reduction in operation costs. Additional widening considered at several of the ledge areas, would not substantially affect the vessel transit time required or reduce the hazards of navigation.

35. The Commandant of the U. S. Naval Base at Portsmouth, New Hampshire has commented that the selected plan of improvement would benefit naval operations and that if an additional widening of 300 feet at Gangway Rock were accomplished, the capability of maneuvering heavier and deeper craft at the Naval Shipyard would be improved. However, the additional 300 feet would result in a fringe benefit to the Navy, but is not an operational necessity.

AIDS TO NAVIGATION

36. The United States Coast Guard has been consulted in regard to the need for establishing additional aids to navigation from Henderson Point to the turning basin at the head of the proposed channel. Additional aids would be required only for the improvement above Boiling Rock. The first costs and the annual maintenance costs for the additional aids considered necessary are as follows:

First Cost:	$ 21,000
Annual Maintenance:	600

SHORE LINE CHANGES

37. The proposed improvements consist of removal of ledge-rock areas and removal of shoal areas which project into the waterway. The material to be removed in relation to the total cross section of the river at these points is such that there will be no appreciable effect upon existing river and tidal currents. Therefore no effect on the shore line will result from the improvement.

ESTIMATES OF FIRST COST

38. Detailed estimates of first cost for improvement of the authorized Piscataqua River channel are given in appendix A of this report. For convenience, the improvement has been divided into two reaches, i.e., upper and lower. The upper reach consists of the improvement to the channel upstream from the limit of the existing Federal project above Boiling Rock to the head of the proposed improvements in Newington. The lower reach consists of improvements to the existing Federal channel from Henderson Point, the southwest tip of Seavey Island, to above Boiling Rock. Dredging quantities were estimated in terms of place measurement based on soundings and probings made during the study, and provide for dredging to the

proposed project depth in ordinary material and ledge-rock, plus an allowance of two feet overdepth in each case. Side slopes of 1 on 3 in ordinary material, and 1 on 1 in ledge-rock were used in the estimates. The unit prices of dredging and rock removal used in estimating the first cost of improvements are based on use of a dipper dredge and scow disposal at sea and on prices prevailing in January 1962. The estimated total first cost for each reach of improvement include the cost for construction, contingencies, engineering and overhead, and supervision and administration. The estimates of the first cost for the upper and lower reaches are summarized below.

First Costs (January 1962)

	Widening Existing Project	Extension to Newington	Total Project
Dredging and rock removal	*$6,700,000	$ 350,000	$7,050,000
Engineering and Design	90,000	10,000	100,000
Supervision and Administration	310,000	40,000	350,000
TOTAL CONSTRUCTION COST	$7,100,000	$ 400,000	$7,500,000
Aids to Navigation	0	21,000	21,000
Pre-Authorization Study Costs	12,000	8,000	20,000
TOTAL PROJECT COST	$7,112,000	$ 429,000	$7,541,000

* Including contingencies.

ESTIMATES OF ANNUAL CHARGES

39. The estimated annual carrying charges have been computed on an assumed project life of 100 years and at an interest rate of 2 5/8 percent on the Federal investment and is given in detail in appendix A of this report and summarized below. There has been no maintenance required for the existing project and none is anticipated in the future in this reach of the river. Maintenance dredging is estimated to be required every 10 years in the upper reach at the location of the present bar.

	Annual Charges		
	Widening Existing Project	Extension to Newington	Total Project
Interest and Amortization	$201,800	$ 12,200	$214,000
Maintenance: Channel		10,000	10,000
Navigation Aids		600	600
TOTAL	$201,800	$ 22,800	$224,600

ESTIMATES OF BENEFITS

40. Improvement of Piscataqua River channel will result in substantial tangible and intangible benefits. Tangible benefits will be realized from savings in shipping costs for the existing and prospective commerce in crude petroleum and refined petroleum products. About one-half of the petroleum received at Portsmouth is overseas traffic originating in the mid-east or South America. The greater part of domestic commerce in petroleum originates in U. S. Gulf ports. In view of the distances involved in overseas and domestic traffic, shippers endeavor to reduce transportation costs by using larger tankers. During World War II, the T-2 tanker of 16,700 Dead Weight Tons proved so conclusively the value of the large type vessels that tankers of over 100,000 DWT are now operating, and vessels of even greater capacities are planned. The larger tankers, now in use or being constructed for this commerce, cannot be utilized in the Portsmouth Harbor trade, because the present channel is inadequate for vessels over 27,000 DWT in the lower reach and 18,000 DWT in the upper reach. With improvement, larger tankers from 27,000 to 35,000 DWT would be able to use the river.

41. The cost of transporting oil in these larger vessels is lower than in the smaller vessels so that annual savings in transportation costs will be realized for that portion of the prospective commerce to be carried in the larger type of vessel. For the smaller tankers in the 17,000 DWT class, no benefits in transportation savings will be realized below Boiling Rock because these tankers can now transit the river at low water slack. However, improvement of the channel above Boiling Rock, where inbound operation is now restricted to periods of high water slack would benefit these vessels by enabling navigation of the river at low water slack also.

42. Tankers of 27,000 DWT now use the river to the upstream limit of the existing project at Boiling Rock. The desired channel widening would allow vessels up to 35,000 DWT to be used with a resultant reduction in the petroleum transportation cost. A larger cost reduction would result for that portion of the commerce handled at the Newington terminals, because present traffic in this reach is limited to 18,000 DWT tankers.

43. Petroleum movement on the Piscataqua River is estimated to increase over the next 100 years to about 7,300,000 tons. This movement is expected to be carried in tankers varying from 17,000 to 35,000 DWT. Because of the inherent difficulty of forecasting movement of commerce in specific type vessels, it was considered that

representative vessel classes would provide a fair basis for the average movement of vessels. The 16,700, 27,000, 32,000, 35,000 deadweight ton class tankers were used in computation for benefits. The percentage of the total commerce that each class vessel would carry in 1961 and in 2061 was estimated.

44. Transportation costs for each vessel class were computed for Gulf and South American ports. The per ton saving for each class of vessel over the largest class that can now use the lower or the upper reach of the river was determined. Annual benefits were then computed separately for each class of vessel in each reach for both foreign and domestic commerce. Benefits from prospective future commerce increases were converted to an equivalent annual benefit using an interest rate of 4 percent.

45. Benefits are described more fully in appendix B of this report. A summary of the tangible benefits to be realized from improvements of the Piscataqua River for commercial traffic is tabulated below.

Evaluated Benefits from reduced transportation costs for petroleum products

	Widening Existing Project	Extension to Newington	Total Project
Extension to Newington Only		$ 61,300	$ 61,300
Whole Project	$ 333,000	149,000	482,000

46. There would be a major intangible benefit from improvement of the 35-foot channel because of the reduction of the hazard to navigation. Not only would it be possible for larger ships to use the channel, for which the benefits have been computed above, but the risk involved in operating the smaller cargo vessels and colliers will be reduced. That the only accident reported since the existing project was completed in 1956 was the 30 December 1961 grounding of the Ticonderoga is a tribute to the pilots and navigators of the river. A fire with oil spread by tidal currents from a broken tanker could be catastrophic. The evaluated benefits are only a partial measure of the value of the improvement.

COMPARISON OF BENEFITS AND COSTS

47. A comparison of the estimated first costs, annual charges, annual benefits to annual charges for the requested improvement of the Piscataqua River channel is given below.

Comparison of Benefits to Costs

	Widening Existing Project	Extension to Newington	Total Project
Annual Benefits	$ 333,000	$ 149,000	$ 482,000
Annual Charges	201,800	22,800	224,600
Benefit Cost Ratio	1.7	6.5	2.1

* These benefits would be $61,300 if the existing project is not widened, giving a b/c ratio of 2.7 for the extension to Newington alone.

48. The economic analysis shows that the improvement to the upper and lower reaches of the Piscataqua River channel when considered separately have favorable ratios of benefits to costs. The combined project benefit cost ratio is 2.1 to 1 and is economically justified.

PROPOSED LOCAL COOPERATION

49. The benefits to be derived from the improvement to the Piscataqua River channel are general in character and as such, it is considered that no local cash contribution toward first cost of construction of the project should be considered. In accordance with present policies, it is proposed and local interests have agreed to:

a. Provide without cost to the United States all necessary lands, easements, and rights-of-way required for construction of the project and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers. (Rights-of-way will include access to contractor with his equipment to construct the necessary improvements.)

b. Hold and save the United States free from damages that may result from construction and maintenance of the project.

c. Provide and maintain without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depth provided in the related project areas. (The existing berths at the deep-draft terminals are considered adequate for the vessels for which the channel improvement was designed. Future maintenance costs are considered to be self-liquidating.)

APPORTIONMENT OF COSTS AMONG INTERESTS

50. The total cost of construction is estimated at $7,541,000 for initial construction plus $10,600 for annual maintenance. The Corps of Engineers has been apportioned $7,500,000 for initial construction costs, plus $20,000 preauthorization study costs. The United States Coast Guard apportionment is $21,000 with $600 for additional maintenance for navigation aids.

COORDINATION WITH OTHER AGENCIES

51. All Federal, State and local agencies interested in the development of waterways of Portsmouth Harbor and Piscataqua River were notified of the public hearing held 24 May 1960 at Portsmouth, New Hampshire. The Maine Port Authority, Federal, State and local interested parties for the State of Maine were notified and their comments requested.

52. The U. S. Fish and Wildlife Service has been notified and has no objection to the improvement of the deep-draft vessel channel in Piscataqua River, except that spoil material should not be placed in the Isles of Shoals area off Portsmouth Harbor. Their letter is presented in Appendix C of this report. The Commandant of the Navy Base has indicated that additional widening at Gangway Rock may be needed for naval operations. Accomplishment of this work at the same time as the widening recommended in this report would result in construction cost savings. Further coordination will be accomplished on this matter if the recommended project is authorized.

DISCUSSION

53. Portsmouth Harbor is located 45 miles northeast of Boston Harbor and 37 miles southwest of Portland Harbor, at the mouth of the Piscataqua River. The river is about 13 miles long and forms a portion of the boundary of the states of New Hampshire and Maine. The waterway is characterized by sharp bends, swift current and a tortuous natural channel with depths up to 70 feet and generally in excess of 35 feet at mean low water to a point about 0.7 mile above Boiling Rock. The river is the drainage channel of very large tidal basins and is subject to very strong currents that limit the navigation of the river by large vessels to periods of slack tidal currents. Navigation of the river is hazardous because of submerged ledges at bends and constricted areas in the winding channel.

54. Former studies for the improvement of Piscataqua River channel were concerned with the removal of ledge rock and the construction of works to improve current conditions. The work authorized for improvement of the waterway before 1900 was in the limits of Portsmouth Harbor and consisted of a dike from Goat to Newcastle Island, and removing a portion of Gangway Rock to a depth of 20 feet and a portion of the southwest point of Badger's Island to 18 feet. This work was completed in 1892 and no maintenance was required. In 1900 a portion of Henderson Point was removed by the Navy to improve navigation to the Navy Base at Kittery.

55. When the improvements were completed in 1892, the waterway was used by shallow draft vessels traveling to and from the wharves along the waterfront of the city of Portsmouth. From 1892 to 1952, the commercial use of the waterway changed and the deep water reach above the city of Portsmouth was developed for industrial use. In this reach of the Piscataqua River, there are now located the bulk oil terminals of the Esso Standard Oil Company, the Socony-Mobil Oil Company, the Atlantic Terminal Sales Corporation which distributes Gulf Oil products and rents storage to the Shell Oil Company; the coal and oil terminal of the C. H. Sprague and Son Company, the 30,000 KW floating power plant "Resistance" and the 40,000 KW mercury vapor plant of the Public Service Company of New Hampshire, the Simplex Wire and Cable Company, the New England Tank Industries (a tank farm to receive water shipments of fuel for the Pease Air Force Base), and the manufacturing plant of the National Gypsum Company.

56. The industrial use of the river and the use of larger vessels for commerce resulted in the existing project being authorized in 1954 and constructed in 1956. This project provided for ledge removal at Gangway Rock, Badgers Island and Boiling Rock to provide a channel 400 feet wide and 35 feet deep. Traffic above Boiling Rock was not sufficient to justify extension of the channel to Newington at that time.

57. A major increase in the size of petroleum tankers in common use has occurred since the previous study of the harbor. The existing project was designed for T-2 tankers, 524 feet long, and is being used by tankers up to 27,000 Dead Weight Tons 624 feet long. The use of 30,000, 32,000 and 35,000 DWT tankers up to 715 feet long is now desired, and would result in economies in the shipment of oil. The Atlantic Terminal Sales Corporation has increased their storage capacity during the past few years and has constructed a terminal to allow the use of deep-draft tankers. The New England Tank Industries, presently in operation, has recently constructed a dock to allow the use of deep-draft tankers. The planned expansion of existing facilities, the increasing demand for gasoline and petroleum products, the

growing use of deep-draft vessels in coastwise commerce indicate that the deep-draft vessels will continue to increase.

58. The U. S. Naval Base, in Portsmouth Harbor receives deep-draft tankers in addition to submarines, cruisers and aircraft carriers. Great care must be exercised in handling vessels approaching and leaving the yard. Deep-draft vessels transiting the Henderson Point and Gangway Rock area must navigate against the cross currents and avoid movement of vessels at the docks of the U. S. Naval Base, opposite Gangway Rock. During periods of naval activity, this area is constricted due to the fact that several vessels may be moored abreast of each other at the upstream wharf. The sharp turns in the channel and the cross currents make navigation hazardous. Additional widening is needed to permit larger vessels to transit this reach.

59. Strong currents exist in the channel at Badger's Island. Vessels proceeding past this area must sail close to the southwest point of the Island to maintain a steerage course to maneuver into position to pass through the bridge northwest of the Island. Due to the position of the bridge in relation to the navigable channel and the strong currents in the river, navigation of deep-draft vessels passing this area is very hazardous. The channel is not wide enough to permit swinging a large vessel if the bridge is unable to open promptly when required. It is very difficult to keep a vessel in the channel while delayed by the bridge. Additional widening is needed to ease the bends, improve the passage through the bridge, and provide space for turning below the bridge.

60. Boiling Rock area constitutes a hazard to navigation. Directly across the river from Boiling Rock are located a major power plant and two fuel terminals. The narrow width of the river at this point, the mooring of vessels at the wharves and the stronger currents due to constriction of the river serve to make this area difficult to navigate. Widening the bend, which would include removal of the pinnacle of Boiling Rock, would reduce the hazard and permit larger vessels to pass to the western terminals. Removing the pinnacle would eliminate the counter-current that it now causes, and the present hazard to small boats. Because widening to allow turning large vessels from the terminal docks is not feasible, a turning basin is needed immediately upstream from Boiling Rock.

61. The travel of deep-draft vessels to terminals above Boiling Rock require the same channel depths as travel to terminals below Boiling Rock. Some of the larger oil companies situated on the banks of the Piscataqua River are above Boiling Rock. There are known

shoals in the channel leading from Boiling Rock to the Atlantic Terminal Sales Corporation in Newington (the upper commercial terminal on the river) which would afford depths less than 35 feet below mean low water. The removal of these shoals plus the enlargement of the river channel at the end of the project area for a turning basin will permit 35,000 DWT vessels to transit the waterway on the slack of high water.

62. The provision of an adequate channel in the ledge-rock areas from Henderson's Point to Newington in the Piscataqua River would remove the major navigation hazards that are now experienced by mariners in trasiting the river. The removal of ledge rock will also result in savings in transportation cost from the use of larger tankers and savings of operational costs of T-2 tankers in the form of savings in time by allowing low water slack operation above Boiling Rock. Based on the use of the waterway by deep-draft vessels, expected expansion of industrial and manufacturing plants located on the river banks and increased use of petroleum products, it is estimated that the average annual use of waterway over the life of the project will increase tremendously.

63. The trend toward using larger tankers has also had its effect on coastwise trade in petroleum products. It is recognized that considerable local benefits would accrue from savings in transportation costs of petroleum products should the oil companies situated in the upper reach of the project area elect to receive their petroleum products in deep-draft tankers in lieu of the small vessels now employed. The companies in this area have already expanded and modernized their terminals in the waterway to accommodate the larger vessels; therefore, it is considered that the prospective commerce in petroleum products will be carried in considerably larger tankers than at present. It is estimated that the maximum size of these ships will be about 35,000 DWT. The channel depth, current problems and bridge limitations would restrict the use of larger vessels. Further improvements to permit larger vessels would not be justified at this time.

64. A channel layout is indicated on the plans accompanying this report, from Henderson's Point to a point about 1,700 feet beyond the Atlantic Terminal Sales Corporation in Newington. The layout is suggested as being feasible and establishes a channel limit in the areas between the locations of considered improvements as well as defining the areas of improvement. Local interests have indicated that this improvement would meet present needs.

65. The improvement to the lower reach of the Piscataqua River would result in substantial savings from the use of larger vessels. It is estimated that widening the existing project channel in the Piscataqua River would cost $7,112,000. An annual benefit of $333,000, and annual charges of $201,800 result in a benefit-cost ratio of 1.7 to 1.

66. The extension of the Federal project channel to Newington would result in operation cost savings for T-2 tankers by allowing them to operate at low water slack, as well as yielding substantial savings from use of larger tankers. It is estimated that extending the channel in the upper reach of the river would cost $429,000. An annual benefit of $149,000 and annual charges of $22,800 result in a benefit-cost ratio of 6.5 to 1. If the existing project is not widened, benefits for the extension to Newington alone would be $61,300 giving a benefit-cost ratio of 2.7 to 1.

67. The improvement costs, annual benefits and annual charges for the upper and lower reach of the Piscataqua River channel have been estimated separately for convenience; however, for project purposes the upper and lower reaches should be combined into one project of improvement, with a resulting cost for the whole project of $7,541,000, annual charges of $224,600, annual benefits of $482,000 and a benefit-cost ratio of 2.1 to 1.

CONCLUSION

68. The Division Engineer concludes that modification of the existing project on the Piscataqua River is warranted to provide for removal of ledge rock in the vicinity of Henderson's Point, Gangway Rock, Badger's Island, and Boiling Rock, including removal of the 26-foot shoal above the Maine-New Hampshire Interstate Bridge; to a depth of 35 feet below mean low water to widen the channel as required to permit navigation by larger tankers. He considers extension of the channel from Boiling Rock to a point of about 1,700 feet above the Atlantic Terminal Sales Corporation in Newington to provide a channel generally 400 feet wide, 35 feet deep below mean low water with maneuvering basins above Boiling Rock and at the head of the project in Newington is warranted to allow safe navigation of deep-draft vessels. The modification of the project can be accomplished at a construction cost of $7,500,000, plus $21,000 for additional aids to navigation. Preauthorization study costs are $20,000. Additional annual maintenance costs are estimated as $10,000 for maintenance dredging and $600 for maintenance of additional navigation aids.

69. The Division Engineer further concludes that additional widening of the channel beyond that above estimated, to an extent of 300 feet of additional width opposite Henderson Point, as recommended by U. S. Navy officials of the Portsmouth Navy Yard has value to the military operation of the base, although not required for commercial navigation of the river. An approximate estimate of cost of this widening is in the order of magnitude of $5,000,000. The Division Engineer concludes that authorization of this additional widening is properly a decision for the Congress to make based on their determination of the need for this expenditure for the national defense.

70. Widening of the existing project and extension of the channel to Newington are separable units that could function independently. They both have a favorable benefit-cost ratio if constructed alone. It is therefore concluded that improvement of either the lower or the upper reach of the Piscataqua River is separately justified.

RECOMMENDATION

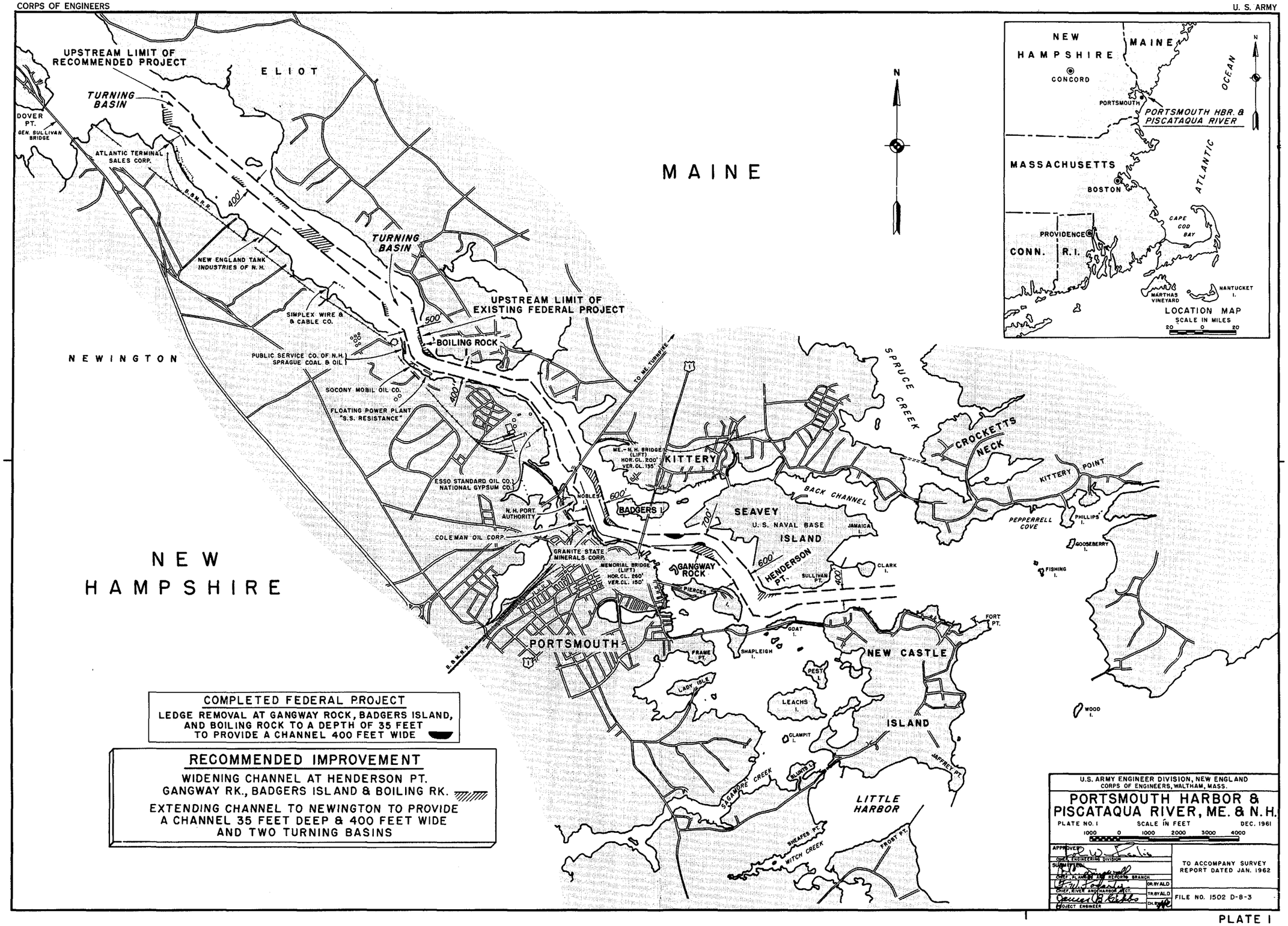
71. The Division Engineer recommends that the existing project at Portsmouth Harbor and Piscataqua River, New Hampshire and Maine, be modified to provide for widening the 35-foot channel at bends by the removal of ledge rock areas in the vicinity of Henderson's Point, Gangway Rock, Badger's Island, the Maine-New Hampshire Interstate Bridge and Boiling Rock; and extension of the Federal channel from Boiling Rock to a point of about 1,700 feet above the Atlantic Terminal Sales dock in Newington to provide a channel generally 400 feet wide, 35 feet deep below mean low water with maneuvering basins above Boiling Rock and at the head of the project; all as shown on the plan accompanying this report and provided that either improvement may be undertaken independently whenever funds are available. The modification to the project to be accomplished subject to the requirement that no construction work on the project modification shall be accomplished until local interest agree to hold and save the United States free from damages due to the construction and maintenance of the project; obtain all land, easements, and rights of way necessary for the construction and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers; and provide and maintain without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depths provided in the related project areas.

72. The construction cost of this improvement is estimated to be $7,500,000, with additional annual maintenance of $10,000.

SEYMOUR A. POTTER, JR.
Brigadier General, USA
Division Engineer

CORPS OF ENGINEERS

U. S. ARMY



NEW HAMPSHIRE

COMPLETED FEDERAL PROJECT

LEDGE REMOVAL AT GANGWAY ROCK, BADGERS ISLAND, AND BOILING ROCK TO A DEPTH OF 35 FEET TO PROVIDE A CHANNEL 400 FEET WIDE

RECOMMENDED IMPROVEMENT

WIDENING CHANNEL AT HENDERSON PT. GANGWAY RK., BADGERS ISLAND & BOILING RK.

EXTENDING CHANNEL TO NEWINGTON TO PROVIDE A CHANNEL 35 FEET DEEP & 400 FEET WIDE AND TWO TURNING BASINS

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

PORTSMOUTH HARBOR & PISCATAQUA RIVER, ME. & N.H.

PLATE NO. I — SCALE IN FEET — DEC. 1961

1000 0 1000 2000 3000 4000

APPROVED:
CHIEF, ENGINEERING DIVISION
SUBMITTED:
CHIEF, PLANNING AND REPORTS BRANCH
CHIEF, RIVER AND HARBOR SECT. — DR. BY ALD
PROJECT ENGINEER — TR. BY ALD — CH. BY

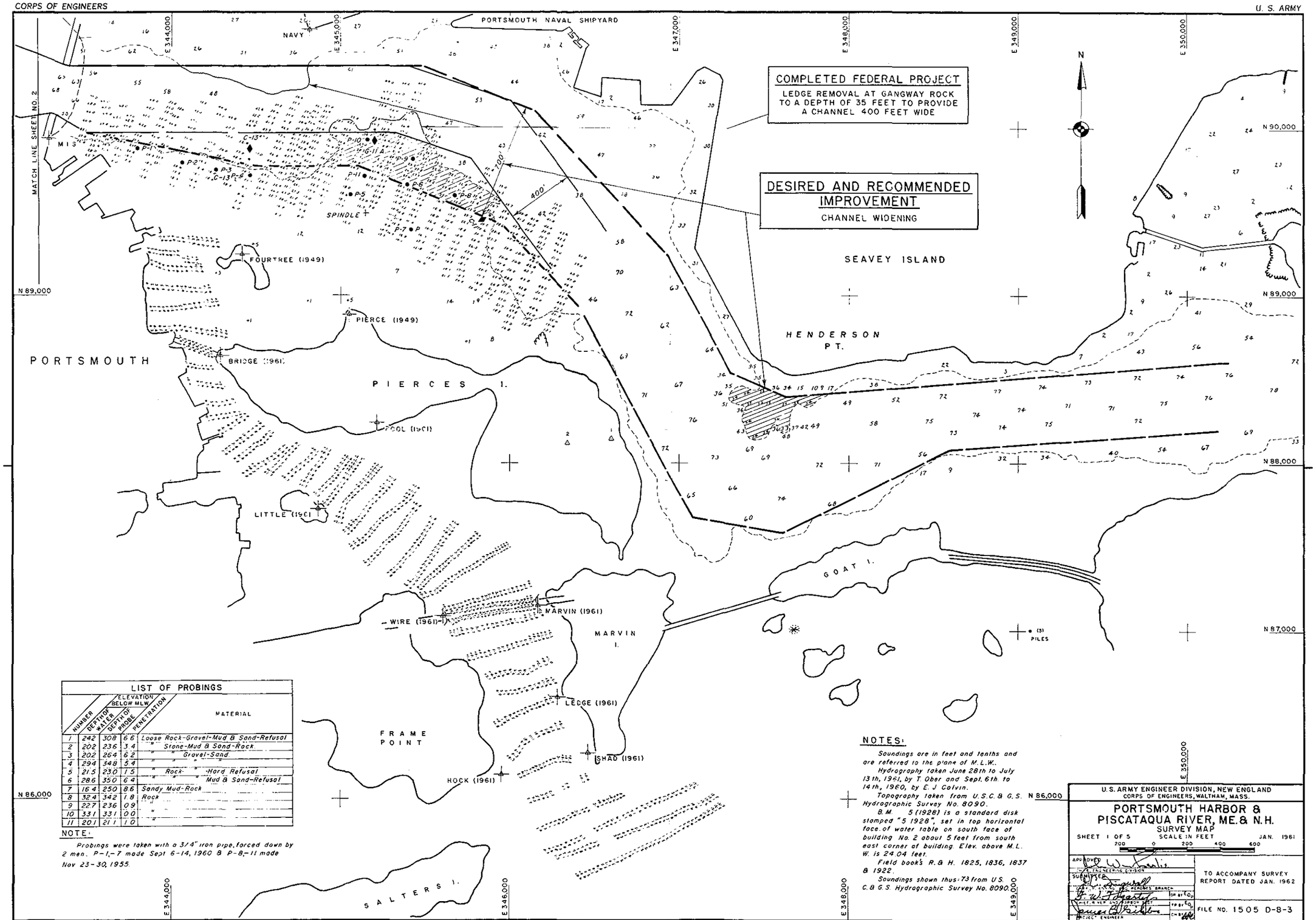
TO ACCOMPANY SURVEY REPORT DATED JAN. 1962

FILE NO. 1502 D-8-3

PLATE I

CORPS OF ENGINEERS

U. S. ARMY



LIST OF PROBINGS

NUMBER	DEPTH OF WATER (ELEVATION BELOW MLW)	DEPTH OF PROBE (ELEVATION BELOW MLW)	PENETRATION	MATERIAL
1	24.2	30.8	6.6	Loose Rock-Gravel-Mud & Sand-Refusal
2	20.2	23.6	3.4	Stone-Mud & Sand-Rock
3	20.2	26.4	6.2	" " Gravel-Sand
4	29.4	34.8	5.4	" " " "
5	21.5	23.0	1.5	" Rock- " -Hard Refusal
6	28.6	35.0	6.4	" " " Mud & Sand-Refusal
7	16.4	25.0	8.6	Sandy Mud-Rock
8	32.4	34.2	1.8	Rock
9	22.7	23.6	0.9	"
10	33.1	33.1	0.0	"
11	20.1	21.1	1.0	"

NOTE:

Probings were taken with a 3/4" iron pipe, forced down by 2 men. P-1,-7 made Sept 6-14, 1960 & P-8,-11 made Nov 23-30, 1955.

NOTES:

Soundings are in feet and tenths and are referred to the plane of M.L.W.

Hydrography taken June 28th to July 13th, 1961, by T. Ober and Sept. 6th to 14th, 1960, by E. J. Colvin.

Topography taken from U.S.C.& G.S. Hydrographic Survey No. 8090.

B.M. 5 (1928) is a standard disk stamped "5 1928", set in top horizontal face of water table on south face of building No. 2 about 5 feet from south east corner of building. Elev. above M.L.W. is 24.04 feet.

Field book's R.& H. 1825, 1836, 1837 & 1922.

Soundings shown thus: 73 from U.S. C.& G.S. Hydrographic Survey No. 8090.

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

PORTSMOUTH HARBOR & PISCATAQUA RIVER, ME. & N.H.

SURVEY MAP

SHEET 1 OF 5 SCALE IN FEET 200 0 200 400 600 JAN. 1961

APPROVED
CHIEF, ENGINEERING DIVISION

SUBMITTED
CHIEF, ENGINEERING BRANCH
CHIEF, RIVER AND HARBOR SECT.
PROJECT ENGINEER

DR BY EO
TR BY EO
CH BY

TO ACCOMPANY SURVEY REPORT DATED JAN. 1962

FILE NO. 1505 D-8-3

PLATE 2

CORPS OF ENGINEERS

U.S. ARMY

LIST OF PROBINGS

NUMBER	DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE	ELEVATION BELOW M.L.W. PENETRATION	MATERIAL
1	20.3	23.4	3.1	Sand and Mud to Hard Clay - Refusal
2	20.8	24.6	3.8	Gravel to Rock
3	+1.1	1.2	2.3	" " "
4	10.2	13.0	2.8	" " Hard Clay to Refusal
5	0.6	0.6	0.0	Rock
6	15.0	19.8	4.8	Coarse Gravel and Sand to Refusal
7	18.4	25.1	6.7	Sand and Gravel to Refusal
8	27.5	40.6	13.1	Mud and Sand
9	33.2	40.8	7.6	Mud and Sand
10	10.7	14.3	3.6	Gravel to Mud and Sand to Gravel to Refusal
11	+1.6	8.0	9.6	Mud to sticky mud to Hard Clay to Refusal
12	7.0	9.5	2.5	Gravel to Refusal
13	9.2	11.7	2.5	Mud and Sand to Gravel to Clay to Refusal
14	15.3	20.2	4.9	Gravel to Mud and Sand to Refusal
15	21.5	24.3	2.8	Loose Stone to Gravel to Refusal

NOTE

Probings taken with 3/4" iron pipe (pointed) forced down by two men from skiff. Attempted wash probings, but more penetrations gained by forcing, with exception of Probe #11. Probes 1-15 made Sept. 16-23, 1960.

NOTES:

Survey of Sept. 15-23, 1960 by E. J. Colvin

B.M. "1 (1948) Standard disk stamped "Tidal No. 1 (1948)" flush in concrete dock floor 145 ft. west of southwest corner of building. 15 ft. south of north face of bulkhead, 23 ft. east of northwest corner west end of dry dock No. 3. Elevation above M.L.W. is 14.16 ft.

Field books: R. & H. 1783, 1793 & 1829

Topography and soundings shown thus: 51 taken from U.S.C. & G.S. Hydrographic Surveys No. 8090 & 8092

DESIRED AND RECOMMENDED IMPROVEMENT
CHANNEL WIDENING

COMPLETED FEDERAL PROJECT
LEDGE REMOVAL AT BADGERS ISLAND TO A DEPTH OF 35 FEET TO PROVIDE A CHANNEL 400 FEET WIDE

N 96,000 | N 95,000 | N 94,000 | N 93,000 | N 92,000 | N 91,000 | N 90,000

E 344,000 | E 343,000 | E 342,000 | E 341,000 | E 340,000

MAINE

NEW HAMPSHIRE

KITTERY

PORTSMOUTH

NEW HAMPSHIRE

BADGER

BADGERS ISLAND

NOBLES ISLAND

M-2-N

MEMORIAL BRIDGE

M-1-S

MATCH LINE SHEET NO. 1

MATCH LINE SHEET NO. 3

T-2-N

CRIB

NEW HAMPSHIRE

600'

400'

GRANITE STATE MINERALS CORP.

Flood

Ebb

COLEMAN OIL CO.

NEW HAMPSHIRE PORT AUTHORITY

ARCH MAINE BRIDGE

T-1-S

B. & M. R. R.

NATIONAL GYPSUM CO & ESSO STANDARD OIL CO.

N

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

PORTSMOUTH HARBOR & PISCATAQUA RIVER, ME. & N.H.
SURVEY MAP

SHEET 2 OF 5 | SCALE IN FEET 200 0 200 400 600 | JAN. 1962

APPROVED:
CHIEF, ENGINEERING DIVISION

CHIEF, PLANNING AND ANALYSIS BRANCH

CHIEF, RIVER AND HARBOR SECT.

PROJECT ENGINEER

DR. BY CO.
TR. BY AOC
CH. BY

TO ACCOMPANY SURVEY REPORT DATED JAN. 1962

FILE NO. 1505 D-8-3

PLATE 3

CORPS OF ENGINEERS

U. S. ARMY

E 334,000 | E 335,000 | E 336,000 | E 337,000 | E 338,000 | E 339,000 | E 340,000

N 99,000 | N 98,000 | N 97,000 | N 96,000 | N 95,000

ELIOT MAINE

N

MATCH LINE SHEET NO. 4

UPSTREAM LIMIT OF EXISTING FEDERAL PROJECT

DESIRED AND RECOMMENDED IMPROVEMENT

CHANNEL WIDENING AND EXTENSION AND TURNING BASIN 35 FEET DEEP

COMPLETED FEDERAL PROJECT

LEDGE REMOVAL AT BOILING ROCK TO A DEPTH OF 35 FEET TO PROVIDE A CHANNEL 400 FEET WIDE

POWER

MERC

PUB. SERVICE CO. OF N. H. SCHILLER STATION C.H. SPRAGUE & SONS COAL & OIL TERMINAL

OIL

SOCONY MOBILE OIL CO.

FLOATING POWER PLANT S. S. RESISTANCE

BOILING ROCK

P-32 P-33 P-31 P-29 P-30 P-28 P-26 P-25

OVAL

ELM

STONE

Flood

Ebb

650'

550'

500'

400'

MATCH LINE SHEET NO. 2

NOTES:

Soundings and probings are in feet and tenths and are referred to the plane of M.L.W.

Hydrography from survey of Nov. 23rd. to 30th., 1955, by K B Cole.

Topography and soundings shown thus: 57 are from U.S.C. & G.S. Hydrography Survey No. 8092.

Probings were taken with a 3/4" pointed iron pipe forced down by 2 men. P-25,-33 made Nov. 23-30, 1955.

LIST OF PROBINGS

NUMBER	DEPTH OF WATER (ELEVATION BELOW M.L.W.)	LIMIT OF PROBING (ELEVATION BELOW M.L.W.)	PENETRATION	MATERIAL
25	28.9	30.2	1.3	Rock
26	37.9	38.6	0.7	"
28	18.7	20.1	1.4	"
29	21.8	23.4	1.6	"
30	30.9	32.8	1.9	"
31	17.1	18.0	0.3	"
32	8.9	10.3	1.4	"
33	11.8	11.8	0.0	"

PORTSMOUTH NEW HAMPSHIRE

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

PORTSMOUTH HARBOR & PISCATAQUA RIVER, ME. & N.H.

SURVEY MAP

SHEET 3 OF 5 — SCALE IN FEET 200 0 200 400 600 — JAN. 1962

APPROVED
CHIEF, ENGINEERING DIVISION

SURVEYED
CHIEF, PLANNING AND REPORTS BRANCH

DRAWN BY E.O.
TRACED BY E.O.
CHECKED

CHIEF, RIVER AND HARBOR SECTION

PROJECT ENGINEER

TO ACCOMPANY SURVEY REPORT DATED: JAN. 1962

FILE NO. 1505 D-8-3

PLATE 4

CORPS OF ENGINEERS — U. S. ARMY

E 328,000 — E 329,000 — E 330,000 — E 331,000 — E 332,000 — E 333,000 — E 334,000 — E 335,000

N 103,000 — N 102,000 — N 101,000 — N 100,000 — N 99,000 — N 98,000

FRANKFORT ISLAND

ISLE

MATCH LINE SHEET NO. 5

P-12 P-11 P-16 P-13 P-15 P-14 P-19

PIER (1960)

DOCK (1960)

LEDGE (1960)

RAILROAD

NEW ENGLAND TANK INDUSTRIES OF NEW HAMPSHIRE

BANK (1960)

SLOPE (1960)

P-10

Flood Current

SIMPLEX (1960)

SIMPLEX WIRE & CABLE CO.

MATCH LINE SHEET NO. 5

ELIOT MAINE

NEWINGTON NEW HAMPSHIRE

N

LIST OF PROBINGS

NUMBER	DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE PENETRATION	MATERIAL
1	35.5	40.1	4.8 Sand & gravel to hard
2	31.1	40.0	8.9 " " " sand
3	30.3	33.5	3.2 " " to hard refusal
4	29.5	34.3	4.9 " " " "
5	27.7	33.7	6.0 " " " "
6	31.0	34.3	3.3 " " " "
7	34.8	41.4	6.6 Crust - Gravel - Sticky Clay
8	28.5	32.1	3.6 Sand - Gravel - Hard Refusal
9	28.8	32.3	3.5 " " " "
10	27.0	32.1	5.1 " " " "
12	25.0	29.0	4.0 Gravel - Refusal (Rock)?
13	29.9	31.5	1.6 Gravel Loose Stone - Refusal
14	29.3	35.9	6.6 Coarse Gravel - Sand & Mud
15	32.7	37.3	4.6 Loose Gravel - Coarse Gravel - Refusal
16	28.6	32.8	4.2 Small Boulders & Cobbles - Gravel - Ref.
17	18.0	19.9	1.9 Loose Gravel - Stone - Refusal
19	23.2	27.1	3.9 Loose Stone - Gravel - Refusal

NOTE:

Probings taken with a pointed 3/4" iron pipe forced down by 2 men. P-1,-19 made Aug. 26 to Sept. 2, 1960.

DESIRED AND RECOMMENDED IMPROVEMENT

CHANNEL ——— 35 FEET DEEP

NOTES:

Survey of Aug. 25, 1960, by H. A. Fishlock.

B.M. No. 1 (1954) is a standard disk stamped "No. 1 1954" set at south corner of Simplex Wire and Cable Co. Wharf, 3 feet northeast of southwest face of wharf. Elev. above M.L.W. is 14.99 feet.

Field book's R. & H. 699, 1184, 1822, 1823, & 1828.

Topography and soundings shown thus: from U.S.C. & G.S. Hydrographic Survey No. 8092

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

PORTSMOUTH HARBOR & PISCATAQUA RIVER, ME. & N.H.

SURVEY MAP

SHEET 4 OF 5 — SCALE IN FEET 200 0 200 400 600 — JAN. 1962

APPROVED: [signature]
CHIEF, ENGINEERING DIVISION

SURVEYED: [signature]
CHIEF, PLANNING AND REPORTS BRANCH

DRAWN BY [signature]
N.E. RIVER AND HARBOR SEC.

TRACED BY [signature]

CHECKED BY [signature]
PROJECT ENGINEER

TO ACCOMPANY SURVEY REPORT DATED: JAN. 1962

FILE NO. 1505 D-8-3

PLATE 5

CORPS OF ENGINEERS

U. S. ARMY

E 324,000 E 325,000 E 326,000 E 327,000 E 328,000 E 329,000 E 330,000

N 106,000

N 105,000

N 104,000

N 103,000

N 102,000

ELIOT MAINE

DOVER POINT

NEWINGTON

NEW HAMPSHIRE

MAST COVE

PINE (1960)

ROCK (1960)

SHELL (1960)

DECK (1960)

ISLE (1960)

FRANKFORT ISLAND

FIXED BRIDGE
HOR. CL. 200'
VERT. CL. 33' M.H.W.
(46' for middle 100')

General Sullivan bridge

Many small rocks covered with seaweed.

C-9

Flood

Ebb

860'

500'

400'

ATLANTIC TERMINAL SALES CORP.

Dolphins

Cribs

Piles

N-6

R16

MATCH LINE SHEET NO. 4

LIST OF PROBINGS

NUMBER	DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE	PENETRATION	MATERIAL
11	31.3	37.4	6.1	Mud & Sand, Refusal
18	29.8	32.7	2.9	Loose stone-Gravel-Refusal

NOTE:
Probings taken with a pointed 3/4" iron pipe forced down by 2 men in a skiff. P-11 & 18 made Aug. 31 to Sept. 2, 1960.

DESIRED AND RECOMMENDED IMPROVEMENT

CHANNEL AND TURNING BASIN 35 FEET DEEP

NOTE:
For general notes see sheet 4 of 5.

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

PORTSMOUTH HARBOR & PISCATAQUA RIVER, ME. & N.H.

SURVEY MAP

SHEET 5 OF 5 — SCALE IN FEET 200 0 200 400 600 — JAN. 1962

APPROVED:

CHIEF, ENGINEERING DIVISION

SUBMITTED:

CHIEF, RIVERS & HARBORS BRANCH

CHIEF, RIVERS AND HARBORS SECT.

PROJECT ENGINEER

TO ACCOMPANY SURVEY REPORT DATED: JAN. 1962

FILE NO. 1505 D-8-3

PLATE 6

INTERIM REPORT ON COMMERCIAL CHANNEL
PORTSMOUTH HARBOR AND PISCATAQUA RIVER
NEW HAMPSHIRE AND MAINE

APPENDIX A - ESTIMATES OF FIRST COST AND ANNUAL CHARGES

1. General. - This appendix presents information on the detailed estimates of first costs, and annual charges of the requested improvements to the existing Piscataqua River channel project, as described in the plan of improvement considered in this report. The improvement for the harbor and lower river for widening, and easing of bends along the authorized deep-draft channel. The improvement for the upper reaches of the Piscataqua River provides for extending the authorized channel and providing turning basins above Boiling Rock and at the end of the channel. Estimates have been made separately for each reach.

2. Cost estimates. - Detailed estimates of first cost in this appendix include the cost for construction, contingencies, engineering and overhead, and the costs of the preauthorization studies. Estimates of the annual costs of the improvements include interest on the initial investment, amortization of the investment over a 100-year period, and costs of annual maintenance of the improvements.

3. Materials. - The materials to be encountered in providing the requested improvements in the harbor and lower Piscataqua River reaches consist of removing ledge rock and ordinary material. The ledge-rock, after blasting, and ordinary material would be removed by a dipper dredge with disposal in deep water areas. Ordinary material in the upper river reaches consists of sand and gravel.

4. Unit prices. - The unit prices of dredging used in the estimates for construction cost of the deep-draft channel and basins were based on the estimated costs for use of a modern 10 yard or larger dipper dredge. All estimates of dredging prices were based on recently experienced costs of similar work in the area. Estimates of the number of aids to navigation to be relocated and constructed for the various considered improvements and the estimated cost of construction and maintenance were furnished by the U. S. Coast Guard.

5. Interest rates. - An interest rate of 2.625 percent for Federal investment has been used in computing the annual charges with 0.989 percent for amortization of the investment over a 100-year period.

6. Maintenance. - Estimates of the quantities of maintenance dredging to be removed annually were based on experienced shoaling rate of the existing channel. The estimated costs for maintenance dredging were based on experienced cost of maintenance in the area. Annual maintenance is not anticipated for the channel in the lower reach because the improvement is only the removal of rock areas where shoaling is not expected. Maintenance dredging is estimated to be required every 10 years in the upper reach to remove a shoal at the location of the present bar.

7. Overdepth and side slopes. All estimates of quantities for dredging include an allowance of 2 feet of overdepth dredging in the deep-draft channel and turning basins. Quantities were computed for channel and turning basin side slopes of 1 vertical on 1 horizontal in the rock areas in the lower reaches and 1 vertical on 3 horizontal in the areas of ordinary dredging in the upper reaches.

8. Contingencies, engineering and overhead. - The estimates include allowances to cover contingencies during construction and the estimated engineering, overhead, design cost, and supervision and administration cost. These costs are estimated on the basis of experience in the area.

9. Preauthorization survey and study costs. - The sum of $20,000 has been expended for preauthorization survey and study costs, including preparation of this interim report. The estimated cost of study for the lower reach is $12,000 and for the upper reach $8,000. Since the deep-draft plan of improvement is divided between the lower and upper reaches of the Piscataqua River, the entire $20,000 is included as preauthorization survey and study cost for both reaches of improvement.

10. Estimates of first cost. - Detailed estimates of first cost and annual charges were made for the lower and upper reaches separately and also for the combination of both reaches. Federal improvement for the lower reach consists of removing ledge-rock and ordinary material. Studies made during the survey indicate that dredging will consist of ledge-rock, which will require removal by drilling and blasting the rock and dredging by bucket dredge, with disposal at sea of ordinary material consisting of gravel and mud. Dredging of the sand and gravel bar in the upper reach of the river is also estimated to require a dipper dredge. Cost estimates are based on prices prevailing in January 1962. Estimated project costs for the lower reach, the upper reach, and the total project are shown below.

PROJECT COST ESTIMATE (Lower reach)

Cost Account Number		Cost Estimate (January 1962)
09	CHANNELS	
	(Rock removal, 225,000 cy @ $25.00 $5,625,000)	
	(Dredging 100,000 cy @ $ 2.00 $ 200,000)	
	(Contingencies @ 15% $ 875,000)	$6,700,000
29	PREAUTHORIZATION STUDIES	12,000
30	ENGINEERING & DESIGN	90,000
31	SUPERVISION & ADMINISTRATION	310,000
	TOTAL COST (Corps of Engineers Funds and Non-Federal Contributions)	$7,112,000
	Non-Federal Contributions	0

TOTAL NON-FEDERAL COSTS

Lands and Damages	0
Relocations	0
Other	0

SUMMARY OF ESTIMATED COSTS

Federal Cost	
Corps of Engineers	$7,112,000
Coast Guard	0
Total Federal	$7,112,000
Required Non-Federal Costs	0
TOTAL FEDERAL AND REQUIRED NON-FEDERAL COSTS	$7,112,000

PROJECT COST ESTIMATE (Upper reach)

Cost Account Number		Cost Estimate (January 1962)
09	CHANNELS	
	(Dredging 155,000 cy @ $2.00 $310,000)	
	(Contingencies @ 15% 40,000)	$ 350,000
29	PREAUTHORIZATION STUDIES	8,000
30	ENGINEERING & DESIGN	10,000
31	SUPERVISION & ADMINISTRATION	40,000
	TOTAL COST (Corps of Engineers Funds and Non-Federal Contributions)	$ 408,000

TOTAL NON-FEDERAL COSTS

Lands and Damages	0
Relocations	0
Other	0

SUMMARY OF ESTIMATED COSTS

Federal Cost	
Corps of Engineers	$ 408,000
Coast Guard	21,000
Total Federal	$ 429,000
Required Non-Federal Costs	0
TOTAL FEDERAL AND REQUIRED NON-FEDERAL COSTS	$ 429,000

PROJECT COST ESTIMATE (Whole Project)

Cost Account Number		Cost Estimate January 1962
09	CHANNELS	
	(Rock removal 225,000 cy @ $25.00 $5,625,000)	
	(Dredging 225,000 cy @ $ 2.00 $ 510,000)	
	(Contingencies @ 15% 915,000)	$7,050,000
29	PREAUTHORIZATION STUDIES	20,000
30	ENGINEERING & DESIGN	100,000
31	SUPERVISION & ADMINISTRATION	350,000
	TOTAL COST (Corps of Engineers Funds and Non-Federal Contributions)	$7,520,000
	Non-Federal Contributions	0

TOTAL NON-FEDERAL COSTS

Lands and Damages	0
Relocations	0
Other	0

SUMMARY OF ESTIMATED COSTS

Federal Cost	
Corps of Engineers	$7,520,000
Coast Guard	21,000
Total Federal	$7,541,000
Required Non-Federal Costs	0
TOTAL FEDERAL AND REQUIRED NON-FEDERAL COSTS	$7,541,000

11. Estimates of annual charges. - The estimates of annual charges for the lower reach, the upper reach and the total project are given below.

ESTIMATE OF ANNUAL CHARGES, LOWER REACH

Federal Investment	
Total Federal First Cost	$7,112,000
Federal Annual Charges	
Interest on Investment @ 2 5/8%	$ 186,700
Amortization @ 0.00213 (100 year life)	15,100
Total Federal Annual Charges	$ 201,800

ESTIMATE OF ANNUAL CHARGES, UPPER REACH

Federal Investment	
Total Federal First Cost	$ 429,000
Federal Annual Charges	
Interest on Investment @ 2 5/8%	11,300
Amortization @ 0.00213 (100 year life)	900
Annual Maintenance on Navigation Aids	600
Annual Channel Maintenance	10,000
Total Federal Annual Charges	$ 22,800

ESTIMATE OF ANNUAL CHARGES, WHOLE PROJECT

Federal Investment	
Total Federal First Cost	$7,541,000
Federal Annual Charges	
Interest on Investment @ 2 5/8%	198,000
Amortization @ 0.00213 (100 year life)	16,000
Annual Maintenance on Navigation Aids	600
Annual Channel Maintenance	10,000
Total Federal Annual Charges	$ 224,600

INTERIM REPORT ON COMMERCIAL CHANNEL
PORTSMOUTH HARBOR AND PISCATAQUA RIVER
NEW HAMPSHIRE AND MAINE

APPENDIX B - ECONOMICS

1. General. - This appendix presents detailed studies of the economic effect of widening, deepening, and extending the existing Piscataqua River channel for deep-draft commercial vessels. The economics discussed in this appendix cover improvements of the authorized deep-draft channel from Henderson's Point to and including turning basins above Boiling Rock and at Newington Station. For convenience the river has been divided into two reaches. The work in the lower reach provides for the requested widening, and easing of bends of the authorized channel with a turning basin above Boiling Rock. The work in the upper reach provides for the requested deepening and extension of the existing channel from Boiling Rock to Newington Station, with a turning basin near Newington Station. The improvements are described in detail in the report and are shown on the report maps.

2. Sections of this appendix included (a) commerce (b) vessel traffic, and (c) benefits. The section on commerce presents data on existing commerce and estimates of future commerce. The section on traffic presents data on freight traffic for the year 1959 and a comparative statement of traffic and estimated tonnage for 1961. The section on benefits presents the studies, analyses, and computations that were utilized in deriving the estimated benefits of the improvements presented in this report.

3. The computations and analysis are based on basic commercial statistics compiled annually by the Corps of Engineers, statistical information furnished by maritime and industrial representatives and published studies on vessel sinkage and maneuvering under varying conditions of headway, trim, and hull contour.

COMMERCE

4. A tabulation of the reported commerce for Portsmouth Harbor and traffic on the Piscataqua River for the calendar year 1960 is shown in the main report. A breakdown of vessel round trips and tonnages to the major terminals in 1959 is given in Table 1 below. Table 2 shows the estimated waterborne commerce for 1961. Petroleum and petroleum products moving in both the coastwide and foreign

trade form the principal portion of the seagoing commerce. Studies were made of factors affecting future trends of waterborne commerce, including probable changes in vessel sizes, the general economic trend in the area, and the probable future production and quantity of petroleum and petroleum products which would enter into waterborne commerce. These studies indicate that large changes are expected in the future petroleum tonnage on the waterway. During 1959 total commerce on the waterway was 1,315,369 short tons of which 1,085,146 short tons or about 82 percent was petroleum and petroleum products. It is conservatively estimated that the prospective petroleum and petroleum products on the Piscataqua River will total about 7,300,000 short tons by the year 2061. Table 3 shows the world and U. S. demand for petroleum. The computations for Portsmouth Harbor, based on U. S. demand, are as follows:

Year	U. S. Demand (million barrels)	Portsmouth Harbor (short tons)
1959	3,439	1,087,000
2000	12,500	3,550,000**
2061	25,700*	7,300,000**

* Based on straight line extrapolation of increase from 1959 to 2000.

** Based on conservative estimate that the annual increase of demand at Portsmouth will be 10% less than the average for the U. S.

TABLE 1. 1959 FREIGHT TRAFFIC ON PISCATAQUA RIVER, N. H.

COMPANY	VESSEL	TRIPS	SHORT TONS
Atlantic Sales Corp.			
Shell Oil Co.	Barge	55	65,130
Sun Oil Co.	Barge	17	36,021
New England Tank Industries (Pease Air Base)	None	None	None *
Simplex Wire & Cable Co.	Cargo	26	8,792 ≠
Socony-Mobil Co.	Tankers	20	41,000
Public Service Co. of N. H. (Sprague)	Tankers	50	837,593
	Colliers	12	154,673
Esso Standard Oil Co.	Barges	35	72,350
National Gypsum Co.	Cargo	4	51,136
Coleman Oil Co.	Motor Barges	44	35,100
Other Commerce			2,683
		Total	1,304,478

* Dock under construction.

≠ Does not include government tonnage.

Petroleum	1,087,194 Tons
Other Commerce	228,175 "
Total	1,315,369 Tons

TABLE 2. ESTIMATED 1961 FREIGHT TRAFFIC ON PISCATAQUA RIVER, N. H.

COMPANY	VESSEL	TRIPS	SHORT TONS
Atlantic Sales Corp.			
Shell Oil Co.	Tanker	5	76,000
Sun Oil Co.	Tanker	2	40,000
New England Tank Industries (Pease Air Base)	Tanker	10	160,000
Simplex Wire & Cable Co.	Cargo	28	25,000
Socony Mobil Co.	Tanker	3	47,000
Public Service Co. of N. H.	Tanker	58	954,000
(Sprague)	Collier	12	160,000
Esso Standard Oil Co.	Tanker	5	82,852
National Gypsum Co.	Cargo	4	52,000
Coleman Oil Co.	Barge	25	20,514
	Tanker	1	16,700
		Total -	1,634,066

Petroleum - 1,397,066
Other Commerce - 237,000
Total 1,634,066

TABLE 3. PETROLEUM DEMAND IN MILLION BARRELS

Year	World	U. S.	Per Cent
1946	2,839	1,793	63.2
1947	3,189	1,990	62.6
1948	3,409	2,114	62.0
1949	3,558	2,118	59.6
1950	4,003	2,375	59.1
1951	4,434	2,570	58.9
1952	4,660	2,664	57.2
1953	4,957	2,775	56.8
1954	5,276	2,832	53.8
1955	5,918	3,088	52.3
1956	6,400	3,213	50.3
1957	6,646	3,219	49.5
1958	7,015	3,315	47.3
1959	7,474	3,439	46.1
1975	16,800	6,200	36.9
2000	43,500	12,500	28.75

R 3/62

VESSEL TRAFFIC

5. A survey of current trends in tanker construction in the United States and World shipyards indicates that individual tankers can be expected to increase in length, beam, loaded draft and deadweight tonnage (dwt) in the immediate future. It is estimated that during the economic life of the proposed improvements to the Piscataqua River channel, tankers in excess of 27,000 dwt will comprise about 45 percent of the United States tanker fleet. The size increase is more marked in the vessels engaged in foreign trade where operation of the large vessels is not restricted to the same degree that coastwise vessels are limited by inadequate harbor dimensions. The vessels in the foreign trade apparently have no limit on size since vessels of 100,000 dwt or over are in operation. A review of the detailed statistics on vessel traffic in Portsmouth Harbor in Table 2 shows that the waterway traffic is almost exclusively dominated by tankers. Oil companies and the American Merchant Marine Institute representatives have stated that larger ships would be put into service on the Piscataqua River if adequate navigation facilities were provided for the safe operation of these vessels. It is estimated that tankers of 27,000 to 35,000 dwt would be put into foreign and coastwise trade almost immediately upon completion of the requested improvements. These vessels would not only depend upon additional petroleum commerce but would supplant more than half of the smaller tankers in the existing trade because of the greater economy of the supertankers.

BENEFITS

6. The benefits that are to be derived from deep-draft improvements to the Piscataqua River channel presented in this report are considered to be savings in cost of transportation of petroleum commerce which would result from the use of supertankers larger than T-2's on both reaches, savings on T-2's in the upper reach at low water slack and a reduction in hazards to navigation. Detailed studies made to determine the savings in transportation cost for each of the two reaches presented in this report are described in the following paragraphs:

7. Cost of Operation of Tankers: Estimated hourly operating costs, deadweight tonnage and average operating speeds of several sizes of supertankers were derived from published data. Table 4 presents hourly cost data on supertankers which were used in estimating benefits for tankers operating between U. S. Gulf ports and Portsmouth Harbor. Table 5 presents hourly cost data on supertankers of Panamian and Liberian registry which were used in estimating benefits for tankers operating between South America and Portsmouth Harbor.

TABLE 4. ESTIMATED COSTS OF OPERATING TYPICAL OCEAN-GOING TANKERS
(As of July 1958)

Deadweight (Tons of 2240 lbs)	Dimensions		Draft (loaded)	Design Speed (knots)	Operating Cost (per hour)	
	Length	Beam			At sea	In port
16,700(T-2)	523'6"	68'0"	30'1"	14.5	156	137
20,000	572'0"	75'0"	30'0"	14.5	181	160
19,000	563'0"	75'0"	31'11"	18.0	228	197
26,000	605'0"	84'0"	33'6"	17.0	250	224
28,000	624'7"	84'0"	33'6"	16.0	266	233
30,000	629'8"	84'2"	34'4"	16.5	280	245
32,000	650'0"	90'0"	34'0"	17.0	295	257
35,000	715'0"	93'0"	35'1"	17.5	300	264
38,000	690'0"	93'0"	36'6"	16.5	326	268
45,500	736'0"	102'0"	37'6"	17.0	334	293

TABLE 5. OPERATING COSTS OF PANAMANIAN AND LIBERIAN REGISTRY TANKERS

Class, DWT	Fuel/Day Long Tons	Hourly Operating Cost At Sea	Hourly Operating Cost In Port
16,700	50	$ 112	$ 90
27,000	60	180	155
30,000	70.7	190	160
32,000	73.0	200	168
35,000	76.6	208	176

8. Cost per Ton: The data in Tables 4 and 5 was used in computing the operating cost per ton of the tankers fully loaded on a round trip from the Gulf ports and from South America to Portsmouth Harbor. The following computation for the 32,000 dwt tanker illustrates the method used for computing the cost per ton of moving petroleum.

a. From Gulf to Portsmouth - Average distance 2,100 Nautical Miles.

dwt = 32,000 (long) Fuel = 73 tons/day
Average Speed = 16.5 knots Draft = 34' - 0"

16.5 x 24 = 396 nautical miles per day
2100/396 = 5.31 days, one way
5.31 x 2 = 10.62 days, rd trip at sea
Fuel = 73 x 10.62 = 775 tons
Add 5 days fuel = 73 x 5 = 365 "
Add, water, stores, etc. = 250 = 250 "
1,390 tons

32,000 - 1,390 = 30,610 long tons net cargo
30,610 x 1.12 = 34,283 short tons " "

Cost at Sea	= 10.62 x 24 x $295	= $75,200
Cost at Port	= 24 x $275	= 6,168
Tide delay (5 hrs)*	= 5 x $295	= 1,475
Round trip plus one day in port		= $82,843
$82,843/34,283 tons		= $2.42 per ton

* Average delay for random arrival of vessel limited to high water slack operation. Average delay for 16,700 dwt vessel, which can also enter on low water slack, is 2 hours.

b. From South America to Portsmouth - Average distance distance 2,000 nautical miles.

dwt = 32,000 (long) Fuel = 73 tons/day
Average speed = 16.5 knots Draft = 34' - 0"

16.5 x 24	= 396 nautical miles per day	
2000/396	= 5.06 days, one way	
5.06 x 2	= 10.12 days rd trip at sea	
Fuel	= 73 x 10.12	= 739 tons
Add 5 days fuel	= 73 x 5	= 365 "
Add stores, water, etc.		= 250 "
		1,354 tons

32,000 - 1354 = 30,646 long tons net cargo
30,646 x 1.12 = 34,323 short tons net cargo

Cost at Sea	= 10.12 x 24 x $200	= $48,576
Cost in Port	= 24 x $168	= 4,032
Tide delay (5 hrs)	= 5 x $200	= 1,000
Round trip plus one day in port		= $53,608
$53,608/34,283 tons		= $1.56 per ton

c. The computations of cost per ton of petroleum from Gulf ports and from South America to Portsmouth Harbor for all other tankers are similar to the above. The computed per ton cost of moving petroleum in tankers from U. S. Gulf ports to Portsmouth Harbor in U. S. registry vessels is shown below.

Vessel Class (Long Tons)	Draft (feet)	Cargo Capacity (Short tons)	Cost Per Trip	Cost Per Ton
16,700	30' - 1"	17,525	$48,752	$ 2.78
27,000	33' - 6"	28,889	74,526	2.58
30,000	34' - 4"	32,099	79,475	2.48
32,000	34' - 0"	34,283	82,843	2.42
35,000	35' - 1"	37,610	81,852	2.18

The per ton cost of moving petroleum in tankers from South America to Portsmouth Harbor in foreign registry vessels is shown below.

Vessel Class (Long Tons)	Draft (feet)	Cargo Capacity (Short Tons)	Cost Per Trip	Cost Per Ton
16,700	30'-1"	17,556	$ 33,296	$ 1.90
27,000	33'-6"	28,924	49,634	1.72
30,000	34'-4"	32,100	52,214	1.63
32,000	34'-0"	34,323	53,608	1.56
35,000	35'-1"	37,651	54,186	1.44
45,000	37'-6"	48,593	55,792	1.15

9. Average saving per ton. - Existing conditions limit the size of loaded tankers in the lower reach of the Piscataqua River to 27,000 dwt, and in the upper reach (above Boiling Rock) to 18,000 dwt. After improvement as recommended, vessels up to 35-foot draft, or 35,000 dwt, could navigate the entire channel. Although 16,700 dwt tankers can now navigate the lower reach at both high and low slack water they can enter the upper reach only at high slack water. Because after improvement they could operate at low slack there would be a saving in the transportation cost of petroleum carried in these vessels. This saving is estimated at $0.02 for domestic traffic and $0.03 for foreign traffic. The far more substantial savings possible from use of larger tankers is shown in Table 6.

TABLE 6. SAVING FROM USE OF LARGER TANKERS

Vessel Class (dwt)	Lower Reach		Upper Reach	
	Cost per ton	Saving per ton (Over 27,000 dwt)	Cost per ton	Saving per ton (Over 16,700 dwt)
		Domestic Traffic		
16,700(T-2)	$2.78		$2.80	
27,000	2.58		2.60	0.20
30,000	2.48	0.10	2.50	0.30
32,000	2.42	0.16	2.44	0.36
35,000	2.18	0.40	2.20	0.60
		Foreign Traffic		
16,700	$1.90		$1.91	
27,000	1.72		1.73	0.18
30,000	1.63	0.09	1.64	0.27
32,000	1.56	0.16	1.57	0.34
35,000	1.44	0.28	1.45	0.46

10. Benefits. - Saving in transportation costs. - As explained in paragraph 4 of this appendix the prospective petroleum commerce in short tons at the life of the project is estimated at 7,300,000. It is expected that 45 percent of this commerce will then be in domestic trade and 55 percent in foreign trade. At present 56 percent is in domestic trade and 44 percent in foreign trade, but due to the expected further expansion in foreign production, that fraction of petroleum commerce is estimated to increase. It is also estimated that as at present, 80 percent of the total petroleum commerce or 5,840,000 tons for Portsmouth Harbor will be in the lower reach of the Piscataqua River and 20 percent or 1,460,000 tons in the upper reach. It is estimated that 75 percent of the petroleum commerce for the lower reaches would move in larger tankers if the waterway is improved of which 25 percent will be in 32,000 dwt and 50 percent in 35,000 dwt. Petroleum commerce for the upper reach would also be in larger tankers if the reach is improved and it is estimated that 10 percent or 146,000 tons will move in 27,000 dwt tankers, 30 percent or 438,000 tons in 32,000 dwt's and 45 percent or 657,000 tons in 35,000 dwt's. These percentages represent the average percent expected from year 1961 to 2061. The computations for benefits, based on the above, for the lower reach of the Piscataqua River are tabulated in Table 7 and for the upper reach in Table 8.

11. The amount of petroleum increase from the year 1961 to the year 2061 was obtained as a straight line growth. Therefore the annual equivalent saving for future commerce was computed by utilizing the straight line conversion factor of 0.23980 for 100 years based on a private interest rate of 4 percent. The annual benefit for the lower reach is estimated to be $333,000 and the upper reach $149,000. The total benefit for the whole project is $482,000.

12. An analysis was also made of the benefits that might be expected if only the upper reach was improved. Because of lower reach limitations the largest tanker that could navigate the river would be the 27,000 dwt vessel. It is to be expected that as many shippers as possible would use the largest vessel available. It is estimated that 20 percent of the petroleum commerce would be carried in 16,700 dwt tankers and 75 percent in 27,000 dwt. Since this is twice the amount for 16,700 dwt tankers used for computation in Table 8, the savings in this size tanker would be twice that computed, or $2,258. The 75 percent is 7.5 times the amount used for 27,000 dwt tankers in Table 8 so a benefit 7.5 times larger, or $59,085 would result. The total benefit for the upper reach if only it was improved is therefore $61,300.

13. As noted in the body of the report there are other benefits, such as reduction of navigation hazards and fire risks, that would result from improvement of the Piscataqua River channel for commercial navigation. It is not considered that these are susceptible of monetary evaluation.

TABLE 7 - BENEFITS FOR THE LOWER REACH

Year	% Domestic or Foreign	% In This Vessel	Total Tonnage Expected In This Reach	Tonnage In This Vessel	Savings From Use of This Vessel Over 27,000 Ton Vessel	Growth Factor To Convert To Annual Savings	Annual Savings	Annual Benefit
				Domestic Commerce in 32,000 Ton Tankers				
1961	56	25	1,073,985	150,358	$ 0.16	-	$ 24,057	
	(Increase, 1961 to 2061)			506,642	$ 0.16	0.23980	$ 19,439	
2061	45	25	5,840,000	657,000			$ 43,496	$ 21,748 *
				Foreign Commerce in 32,000 Ton Tankers				
1961	44	25	1,073,985	118,139	$ 0.16	-	$ 18,902	
	(Increase, 1961 to 2061)			684,861	$ 0.16	0.23980	$ 26,277	
2061	55	25	5,840,000	803,000			$ 45,179	$ 45,179
				Domestic Commerce in 35,000 Ton Tankers				
1961	56	50	1,073,985	300,716	$ 0.40	-	$ 120,286	
	(Increase, 1961 to 2061)			1,013,284	$ 0.40	0.23980	$ 97,194	
2061	45	50	5,840,000	1,314,000			$ 217,480	$ 108,740 *
				Foreign Commerce in 35,000 Ton Tankers				
1961	44	50	1,073,985	236,277	$ 0.28	-	$ 66,158	
	(Increase, 1961 to 2061)			1,369,723	$ 0.28	0.23980	$ 91,969	
2061	55	50	5,840,000	1,606,000			$ 158,127	$ 158,127

Total Benefit for Lower Reach = $ 333,794

* Savings on Domestic Traffic Credited 1/2 To Shipping Port

TABLE 8 - BENEFITS FOR THE UPPER REACH

Year	% Domestic or Foreign	% In This Vessel	Total Tonnage Expected In This Reach	Tonnage In This Vessel	Savings From Use of This Vessel Over 16,700 Ton Vessel	Growth Factor To Convert To Annual Savings	Annual Savings	Annual Benefit
Domestic Commerce in 16,700 Ton Tankers								
1961	56	10	276,000	15,456	$ 0.02	-	$ 309.12	
	(Increase, 1961 to 2061)			50,244	$ 0.02	0.23980	$ 240.97	
2061	45	10	1,460,000	65,700			$ 550.09	$ 275 *
Foreign Commerce in 16,700 Ton Tankers								
1961	44	10	276,000	12,144	$ 0.03	-	$ 364.32	
	(Increase, 1961 to 2061)			68,156	$ 0.03	0.23980	$ 490.31	
2061	55	10	1,460,000	80,300			$ 854.63	$ 854
Domestic Commerce in 27,000 Ton Tankers								
1961	56	10	276,000	15,456	$ 0.20	-	$3,091	
	(Increase, 1961 to 2061)			50,244	$ 0.20	0.23980	$2,410	
2061	45	10	1,460,000	65,700			$5,501	$ 2,750 *
Foreign Commerce in 27,000 Ton Tankers								
1961	44	10	276,000	12,144	$ 0.18	-	$2,186	
	(Increase, 1961 to 2061)			68,156	$ 0.18	0.23980	$2,942	
2061	55	10	1,460,000	80,300			$5,128	$ 5,128

TABLE 8 - BENEFITS FOR THE UPPER REACH
(continued)

Year	% Domestic or Foreign	% In This Vessel	Total Tonnage Expected In This Reach	Tonnage In This Vessel	Savings From Use of This Vessel Over 16,700 Ton Vessel	Growth Factor To Convert To Annual Savings	Annual Savings	Annual Benefit
				Domestic Commerce in 32,000 Ton Tankers				
1961	56	30	276,000	46,368	$ 0.36	-	$ 16,692	
	(Increase, 1961 to 2061)			150,732	$ 0.36	0.23980	$ 13,012	
2061	45	30	1,460,000	197,100			$ 29,704	$ 14,852 *
				Foreign Commerce in 32,000 Ton Tankers				
1961	44	30	276,000	36,432	$ 0.34	-	$ 12,387	
	(Increase, 1961 to 2061)			204,468	$ 0.34	0.23980	$ 16,671	
2061	55	30	1,460,000	240,900			$ 29,058	$ 29,058
				Domestic Commerce in 35,000 Ton Tankers				
1961	56	45	276,000	69,552	$ 0.60	-	$ 41,732	
	(Increase, 1961 to 2061)			226,098	$ 0.60	0.23980	$ 32,531	
2061	45	45	1,460,000	295,650			$ 74,263	$ 37,131 *
				Foreign Commerce in 35,000 Ton Tankers				
1961	44	45	276,000	54,648	$ 0.46	-	$ 25,138	
	(Increase, 1961 to 2061)			306,702	$ 0.46	0.23980	$ 33,832	
2061	55	45	1,460,000	361,350			$ 58,970	$ 58,970
							Total Benefits for Upper Reaches	$149,018

* Savings On Domestic Traffic Credited 1/2 To Shipping Port.

APPENDIX C

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
59 Temple Place
Boston, Massachusetts

December 5, 1961

Division Engineer
New England Division
U. S. Army, Corps of Engineers
424 Trapelo Road
Waltham 54, Massachusetts

Dear Sir:

This letter constitutes our conservation and development report on the proposed navigation improvements for Portsmouth Harbor, New Hampshire, and has the concurrence of the New Hampshire Fish and Game Department.

The improvements under consideration consist of two separate items, i.e.:

1. Widening and extending the existing deep-draft vessel channel in the Piscataqua River.

2. Provision of small-boat channels, 100 feet wide by 8 feet deep, between Portsmouth Harbor and Little Harbor, and up Sagamore Creek to State Highway 1A bridge.

Some commercial fishery benefits are anticipated as a result of the construction of the small-boat channels. The proposed small-boat channels would allow the lobster fishermen to travel to their fishing grounds via Little Harbor at all times, rather than only at high tide. Under existing conditions the fishermen have to use the main boat channel and travel around New Castle Island at low tide. The principal commercial fishery benefit would be a savings in operating costs to the lobster fishermen. We are not in a position to place a monetary value on this type of benefit.

With regard to the deep-draft vessel channel in the Piscataqua River, we anticipate no significant adverse effects on the fish and wildlife resources as a result of construction nor from spoil material if placed at sea, except in the Isles of Shoals area. The Isles of Shoals area off Portsmouth Harbor has supported an early winter herring fishery, and we have some indication of herring spawning near the islands in this area. No spoil material should be placed in the Isles of Shoals area.

With regard to your plans for the small-boat channels, we anticipate no significant adverse effects on fish and wildlife resources as a result of dredging operations. We understand that the spoil material will be mud and sand and probably will be placed on land or in tidal areas. The placement

of this spoil material could adversely effect fish and wildlife resources. Disposal of this spoil material will be least damaging to fish and wildlife resources if it is placed on areas outlined on Plate I.

Therefore, we recommend--

1. That spoil material from the deep-draft vessel channel not be placed in the Isles of Shoals area.

2. That all spoil material from the small-boat channels be placed in those spoil areas designated on Plate I.

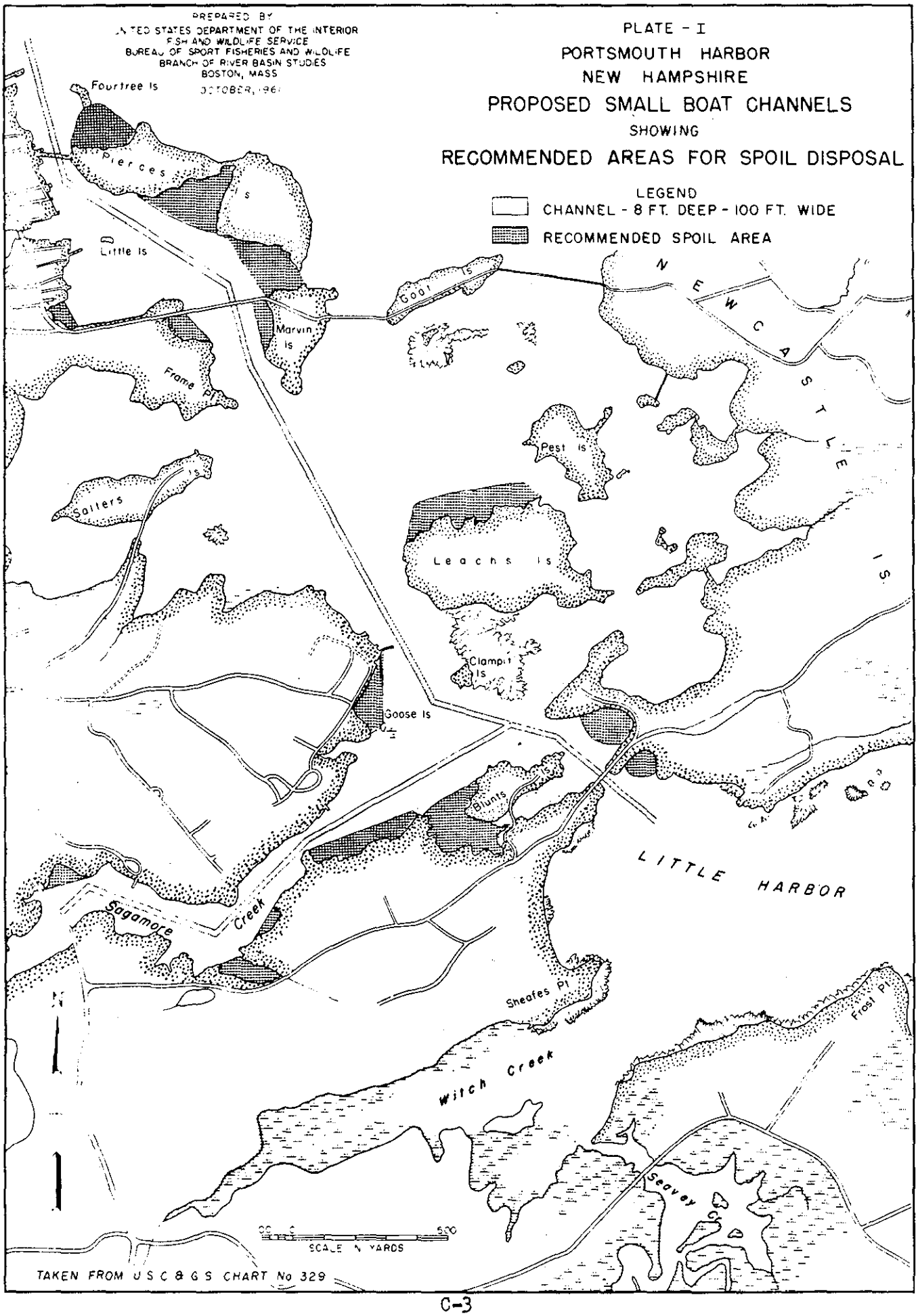
No further studies by this Service will be required if spoil material is placed on the recommended areas. Should additional spoil disposal areas be selected, we would like to have notification sufficiently in advance of contract letting to prepare a new fish and wildlife report.

Thank you for the opportunity to report on this plan of improvement.

Sincerely yours,

E. W. Bailey
Acting Regional Director
Bureau of Sport Fisheries & Wildlife

John T. Gharrett
Regional Director
Bureau of Commercial Fisheries


PREPARED BY
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
BRANCH OF RIVER BASIN STUDIES
BOSTON, MASS
OCTOBER, 1961
PLATE - I
PORTSMOUTH HARBOR
NEW HAMPSHIRE
PROPOSED SMALL BOAT CHANNELS
SHOWING
RECOMMENDED AREAS FOR SPOIL DISPOSAL
LEGEND
CHANNEL - 8 FT. DEEP - 100 FT. WIDE
RECOMMENDED SPOIL AREA
Fourtree Is
Pierces Is
Little Is
Goat Is
Marvin Is
Frame Pt
Salters Is
Pest Is
Leachs Is
Clampit Is
Goose Is
Stunts Is
NEWCASTLE IS.
LITTLE HARBOR
Sagamore Creek
Sheafes Pt
Frost Pt
Witch Creek
Seavey
SCALE IN YARDS
TAKEN FROM U S C & G S CHART No 329

PORTSMOUTH HARBOR AND PISCATAQUA RIVER,
NEW HAMPSHIRE AND MAINE

INFORMATION CALLED FOR BY SENATE RESOLUTION 148, 85TH CONGRESS, 1ST SESSION, ADOPTED 28 JANUARY 1958.

1. Navigation Problems. - Portsmouth Harbor and Piscataqua River, New Hampshire and Maine are located 45 miles northeast of Boston Harbor and 37 miles southwest of Portland Harbor. The Piscataqua River forms a portion of the boundary between the states of Maine and New Hampshire. The mouth of the river is called Portsmouth Harbor. The river is about 13 miles long and has a tortuous channel, sharp bends and submerged ledges making navigation for deep-draft vessels hazardous.

2. The problems involved in handling large vessels in the river due to the strong tidal currents effectively rule out docking and undocking at terminals at any time other than periods of slack water. The lack of turning room in the river, together with sharp bends and poor holding ground for anchorage makes it impossible for vessels to stop and anchor once they enter the river. The rocky nature of the channel further adds to the hazard whereby a minor grounding or touching the sides of the channel would result in serious damage to the vessel. These conditions prevent use of tankers larger than 27,000 deadweight tons.

3. Improvement Considered. - Local interests requested improvement of the deep-draft ship commercial channel of Portsmouth Harbor and Piscataqua River to reduce navigation hazards and permit use of 35,000 deadweight ton tankers to deep-water terminals located up river as far as Newington. Studies of the improvement proposed by local interests were made and with minor changes in the original request to reduce costs, a plan of improvement was developed to allow navigation by the larger vessels.

4. Recommended Improvement. - The modification of the existing project is recommended to provide for widening the existing channel by the removal of ledge rock areas in the vicinity of Henderson's Point, Gangway Rock, the southwest point of Badger's Island, and Boiling Rock, and the extension of the channel from Boiling Rock to Newington. The estimated first costs, annual charges and annual benefits, based on 1961 price levels, a 100-year project life and an interest rate of 2-5/8 percent on Federal funds are as follows:

a. Estimated First Cost of Construction

Federal	$ 7,500,000(1)
Non-Federal	0
Total Estimated First Cost of Construction	$ 7,500,000

(1) Excludes preauthorization study cost of $20,000 and additional navigation aids of $21,000

b. Estimated Annual Charges

	Federal Total
Interest and Amortization	$ 214,000
Maintenance-Project	10,000
Navigation Aids	600
Total Estimated Annual Charges	$ 224,600

c. Estimated Annual Benefits

Reduction of transportation cost for petroleum products: Total	$ 482,000

d. Benefit-Cost Ratio = 2.1 to 1

5. Local Cooperation. - The benefits to be derived from the improvement to the Piscataqua River channel are general in character and as such, no local cash contribution toward first cost of construction of the project should be required. However it is proposed that local interests shall be required to:

a. Provide without cost to the United States all necessary lands, easements, and rights-of-way required for construction of the project and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers. (Rights-of-way will include access to contractor with his equipment to construct the necessary improvements.)

b. Hold and save the United States free from damages that may result from construction and maintenance of the project.

c. Provide and maintain without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depths provided in the related project areas.

6. Discussion. - Local interests have approved the recommended plan of improvement and have indicated that the requirements of local cooperation would be met. The recommended improvement would provide a feasible and economic means of current and prospective needs of navigation in the river. Analysis on the basis of an economic life of 100 years would result in a benefit-cost ratio of 2.1 to 1. The project is considered justified on the basis of studies and criteria utilized in the report.